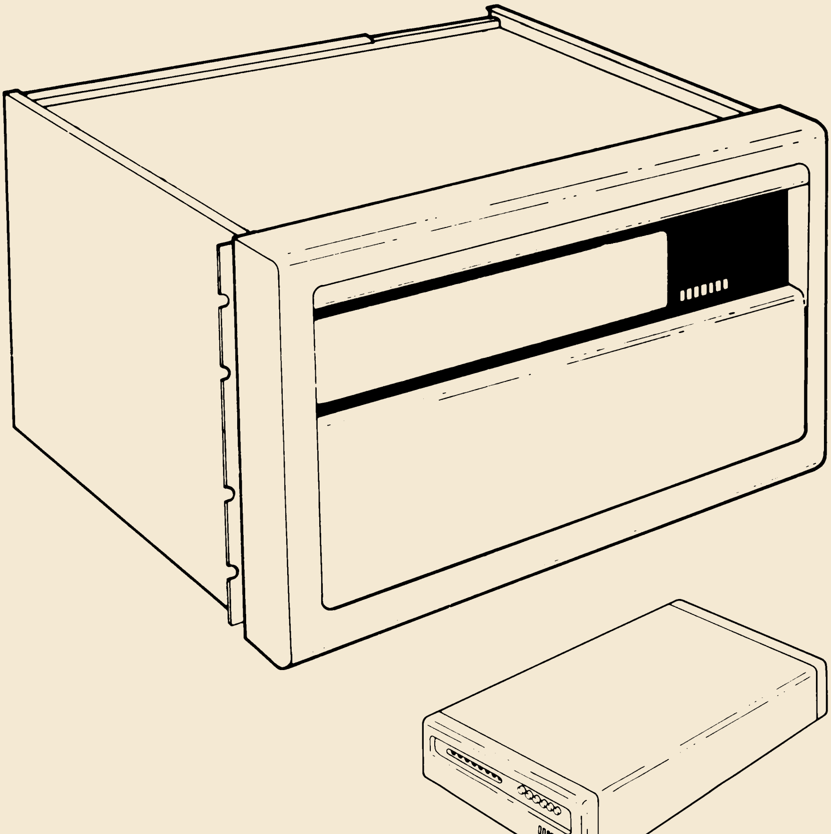
EK-DF112-UG-001

DF112 Modem Family User Guide



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EK-DF112-UG-001

DF112
Modem Family
User Guide

Prepared by Educational Services
of
Digital Equipment Corporation

1st Edition, November 1984

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- Class A Computing Devices:

Notice: This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such radio frequency interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference in which case the user at his own expense may be required to take measures to correct the interference.

- Class B Computing Devices:

Notice: This equipment generates and uses radio frequency energy. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against radio and television interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, the user is encouraged to try to correct the interference.

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CONTENTS

Page

PREFACE

CHAPTER 1 INTRODUCTION

1.1 GENERAL.......... 1-1
1.2 FUNCTIONAL OVERVIEW.......... 1-4
1.3 PHYSICAL DESCRIPTION.......... 1-4
1.3.1 Standalone DF112-AA.......... 1-5
1.3.2 Multiple Modem Configuration.......... 1-6
1.4 FEATURE SUMMARY.......... 1-7
1.4.1 Dual Application Modem.......... 1-7
1.4.2 FCC/DOC Approved.......... 1-7
1.4.3 Packaging.......... 1-7
1.4.4 Configuration.......... 1-8
1.4.5 Installation and Service.......... 1-8
1.5 GENERAL SPECIFICATIONS.......... 1-8
1.5.1 DF112-AM Modem Module.......... 1-8
1.5.2 Standalone Modem Enclosure.......... 1-9
1.5.3 Multiple Modem Enclosure.......... 1-10
1.5.4 Auto Dial Feature.......... 1-11

CHAPTER 2 SITE PREPARATION AND INSTALLATION

2.1 GENERAL.......... 2-1
2.2 REGULATORY AGENCY REQUIREMENTS.......... 2-1
2.2.1 FCC Regulations.......... 2-2
2.2.1.1 FCC Part 68-Direct Connection.......... 2-2
2.2.1.2 FCC Part 15J (RFI/EMI) Verification for DF112-AA.......... 2-3
2.2.1.3 FCC Part 15J (RFI/EMI) Verification for DF112-AM.......... 2-4
2.2.2 DOC Regulations.......... 2-4
2.3 OPERATING ENVIRONMENT.......... 2-5
2.3.1 Standalone DF112 Modem.......... 2-5
2.3.2 Multiple DF112 Modem Configuration.......... 2-5
2.4 UNPACKING AND INSPECTION.......... 2-6

CONTENTS (Cont)

Page

2.5 INSTALLATION 2-7
2.5.1 Standalone DF112 Installation 2-7
2.5.1.1 Installing Standalone Modem Modules 2-8
2.5.1.2 Installing the Standalone Modem to RJ11C (CA11A) Service 2-10
2.5.1.3 Installing the Standalone Modem to RJ41S/RJ45S (CA41A/CA45A) Service 2-15
2.5.1.4 Installing the Standalone Modem to Private Line Service 2-18
2.5.2 Installing the Multiple Modem Enclosure 2-21
2.5.3 Installing Multiple Modem Modules 2-27
2.5.4 Installing DF100-PR Redundant Power Regulator 2-30

CHAPTER 3 OPERATION

3.1 GENERAL 3-1
3.2 CONTROL SWITCHES AND INDICATORS 3-3
3.3 USING THE DF112 ON DIAL-UP SERVICE 3-5
3.3.1 Manual Originate Mode 3-6
3.3.2 Manual Answer Mode 3-7
3.3.3 Automatic Answer Mode 3-7
3.3.4 Automatic Originate (Auto Dial) 3-8
3.4 AUTO DIAL FEATURE 3-8
3.4.1 Dialing Numbers 3-13
3.4.2 Redial Current Number 3-15
3.4.3 Cancelling a Call 3-16
3.4.4 Storing Numbers 3-18
3.4.5 Dialing Stored Numbers 3-19
3.5 AUTO DIAL ORIGINATE – USING TERMINAL CONTROL 3-21
3.6 AUTO DIAL ORIGINATE – USING PROGRAM CONTROL 3-22
3.7 USING THE DF112 ON PRIVATE LINE 3-23

CONTENTS (Cont)

Page

CHAPTER 4 TEST PROCEDURES

4.1 GENERAL 4-1
4.2 TEST AREA 1 - LOCAL TERMINAL TEST 4-3
4.3 TEST AREA 2 - LOCAL LOOPBACK TEST 4-4
4.3.1 Local Loopback Self-test 4-4
4.3.2 Local Loopback 4-5
4.4 TEST AREA 3 - REMOTE DIGITAL LOOPBACK TESTS 4-6
4.4.1 Digital Loopback Tests 4-7
4.4.2 Digital Loopback Self-test 4-9
4.4.3 Remote Digital Loopback 4-10
4.4.4 Remote Digital Loopbck Self-test 4-12
4.5 TEST AREA 4 - END-TO-END SELF-TEST 4-14
4.6 DF112 AUTO DIAL TESTING 4-16

CHAPTER 5 MODEM OPTIONS

5.1 GENERAL 5-1
5.2 STANDALONE MODEM DISASSEMBLY 5-6
5.3 MULTIPLE MODEM ENCLOSURE DISASSEMBLY 5-8
5.4 SELECTING SWITCHPACK OPTIONS 5-8
5.4.1 DF112-AM Modem Module Assembly 5-9
5.4.2 DF112-AM Modem Options 5-11
5.5 DF112 REASSEMBLY 5-20
5.5.1 Standalone Modem Reassembly 5-20
5.5.2 Multiple Modem Enclosure Reassembly 5-22

CHAPTER 6 SERVICE

6.1 GENERAL 6-1
6.2 DF112 SERVICE 6-1
6.3 TELEPHONE COMPANY SERVICE OR EQUIPMENT PROBLEMS 6-1

CONTENTS (Cont)

APPENDIX A LOOPBACK QUICK REFERENCE GUIDE

APPENDIX B EIA/CCITT DATA

APPENDIX C RJ21X (US) OR CA21A (CAN) SIGNAL CONNECTIONS TO CONNECTOR J13

FIGURES

Figure No.	Title	Page
1-1	DF112 Modem Applications	1-2
1-2	Standalone DF112 Modem	1-5
1-3	The DF100-RM Multiple Modem Enclosure	1-6
2-1	Standalone Modem Front Cover Removal	2-9
2-2	Standalone Modem Rear Connector Panel	2-10
2-3	Installing Standalone Modems On RJ11C or Equivalent Service	2-11
2-4	Installing Standalone Modems On RJ41S/RJ45S or Equivalent Service	2-16
2-5	Installing Standalone Modem On Private Lines	2-19
2-6	Multiple Modem Enclosure Rear Connector Panel	2-22
2-7	Multiple Modem Enclosure Installation Diagram	2-24
2-8	Multiple Modem Enclosure Module Placement	2-25
2-9	Multiple Modem Enclosure Interface Cabling	2-26
2-10	Multiple Modem Enclosue PSTN/PLTN Line Connections	2-27
2-11	Modem Identification Label	2-29
2-12	Installing the DF100-PR Power Regulator Module	2-31
2-13	Redundant Power Regulator Interconnect Cable	2-32
3-1	Standalone DF112 Modem Controls and Indicators	3-1
3-2	Multiple Modem Controls and Indicators	3-2
4-1	Data Path Acceptance Test Sequence	4-2
4-2	Local Terminal Test	4-3
4-3	Local Loopback Self-test	4-4
4-4	Local Loopback	4-5
4-5	Digital Loopback	4-7
4-6	Digital Loopback Self-test	4-9
4-7	Remote Digital Loopback	4-10

FIGURES (Cont)

Figure No. **Title** **Page**

4-8 Remote Digital Loopback Self-test 4-12
4-9 End-to-End Self-test 4-14
5-1 Standalone Modem Disassembly 5-7
5-2 Multiple Modem Enclosure Disassembly 5-8
5-3 Switchpack Variations 5-9
5-4 DF112-AM Module Layout 5-10
5-5 DF112-AM Switchpack Locations 5-12
5-6 Standalone Modem Reassembly 5-21
5-7 Multiple Modem Enclosure Reassembly 5-22

TABLES

Table No. **Title** **Page**

3-1 DF112 Modem Front Panel LED Indicators 3-3
3-2 DF112 Modem Front Panel Pushbutton Controls 3-4
3-3 Valid Auto Dial Characters 3-9
3-4 Response Messages 3-10
5-1 Detailed Modem Options Descriptions 5-1
5-2 Detailed Auto Dialer Option Descriptions 5-6
5-3 DF112-AM Switchpack 1 Selections 5-13
5-4 DF112-AM Switchpack 2 Selections 5-15
5-5 DF112-AM Switchpack 3 Selections 5-17
5-6 DF112-AM Switchpack 4 Selections 5-19
B-1 Interface Pin Assignments B-1
C-1 Telephone Connector (J13) Pin Usage C-1

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PREFACE

This manual provides technical information that enables the user to install, test, and operate the Standalone DF112-AA Desk Top Modem and the Rack Mount DF112-AM Modem.

Chapter 1 provides a physical description, functional overview, feature summary, and interface data for the standalone and the rack mount DF112. Chapter 2 contains procedures for proper site setup and installation of both units. Chapter 3 describes the different controls and indicators, describes all modes of operation for both standalone and rack mount features, and includes examples of programming for the auto call feature. Chapter 4 contains a step-by-step sequence of test procedures used to correctly verify modem operations. These procedures are common to both standalone and rack mount units. Chapter 5 describes the optional configurations that are available on the standalone and the rack mount modems and the switchpack selections to implement selected options. Chapter 6 identifies actions that should be taken when service is required.

The selections listed in Chapter 5 are presented in tabular format. Each modem module is shipped from the factory with these options preset to select the most popular variation. In the tables describing these options, factory settings are printed in blue for easy reference. Othe areas of this manual are printed in blue to bring attention to certain features and conditions.

CANADIAN RESTRICTION

CANADIAN APPLICATION NOTICE

The Canadian Department of Communications label identifies certified equipment. This certification means the equipment meets certain telecommunications network protective, operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an approved method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified jack-plug-cord ensemble (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations. Existing telecommunications company requirements do not permit their equipment to be connected to customer-provided jacks except where specified by individual telecommunications company tariffs.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure (for their own protection) that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION: Users should not attempt to make such connections themselves but should contact the appropriate electric inspection authority, or electrician, as appropriate.

CHAPTER 1
INTRODUCTION

1.1 GENERAL

This chapter contains a functional overview, a physical description, a feature summary and a list of general specifications for the DF112 Modem, including the standalone modem and multiple modem enclosures.

Depending upon the application, the standalone modem and the multiple modem enclosures have distinct advantages. In configurations where data communications volume is low, one or two standalone modems would satisfy the requirement. However, in a high-volume communications environment, where several modems are required, the concentrated packaging of the multiple modem enclosure would be more suitable and cost efficient. The diagram of Figure 1-1 provides a simple view of both high- and low-volume applications.

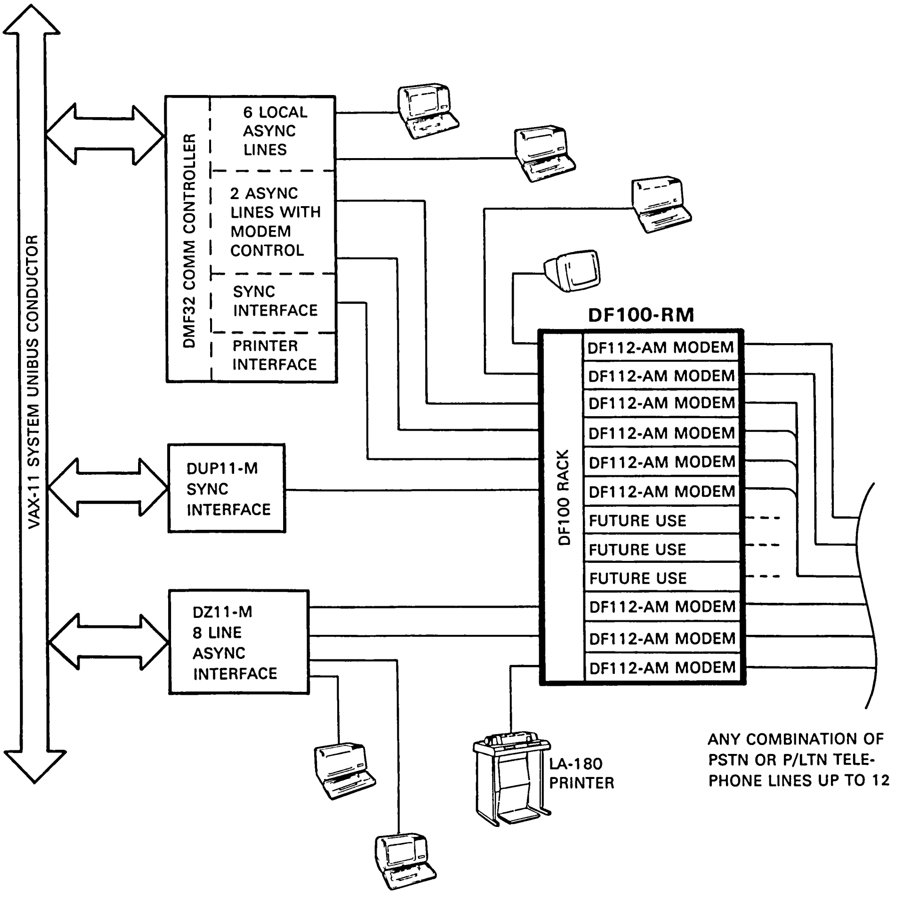


Figure 1-1 DF112 Modem Applications (Sheet 1 of 2)

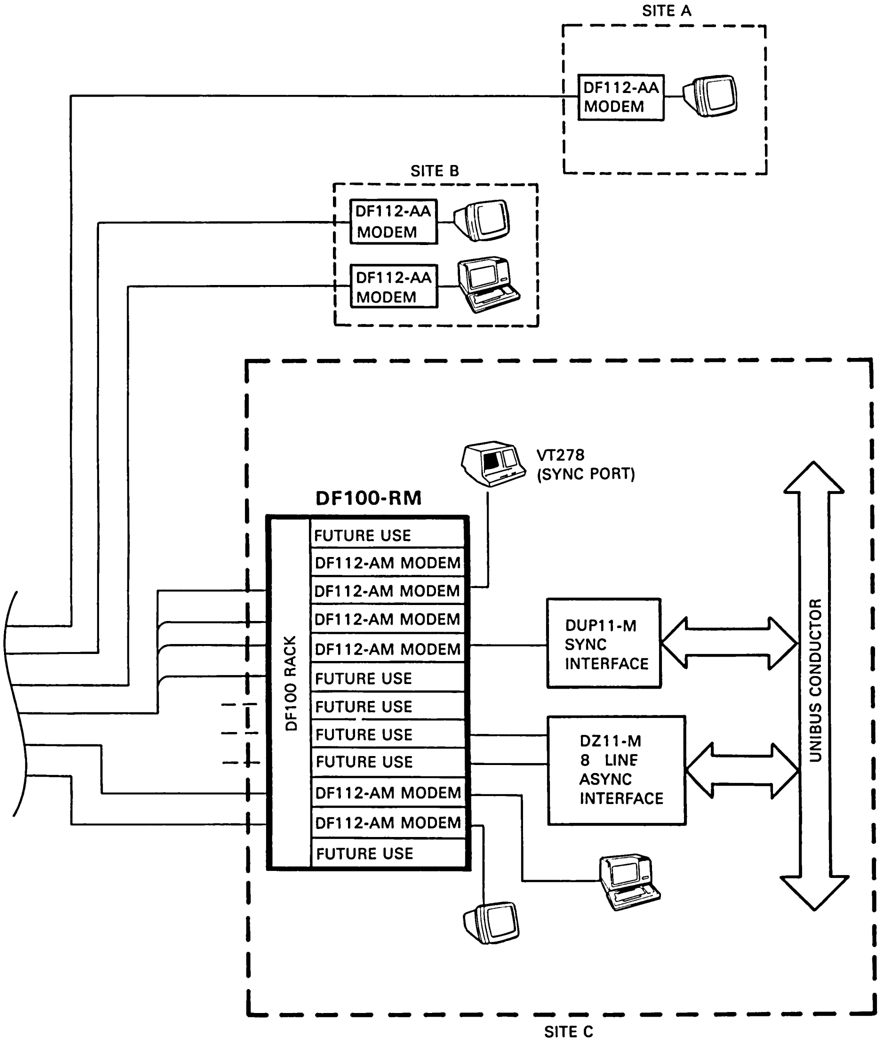


Figure 1-1 DF112 Modem Applications (Sheet 2 of 2)

1.2 FUNCTIONAL OVERVIEW

The DF112 converts serial binary data, generated by the Data Terminal Equipment (DTE), into frequency encoded audio tones and transmits the tones over the telephone lines. Conversely, it converts the audio tones from remote stations into serial binary data and routes the data to the local data terminal equipment. The DF112 provides full-duplex, asynchronous or synchronous, binary serial data communications over two wire, dial-up telephone network or two wire, private/leased telephone network facilities.

Auto dial, auto answer, front panel status lights, and a full line of test features make the DF112 modem family a full-featured product. The auto dial feature allows for automatic dialing of remote stations using either attended terminal control or unattended program control.

Low-speed operation [0 to 300 bits per second (b/s)] is asynchronous, binary frequency shift keying (FSK). High speed operation (1200 b/s) can be either character-asynchronous or bit-synchronous, quaternary differential phase shift keying (QDPSK). The DF112 includes a variety of user selectable options which are factory set for compatibility with the Bell System 103J and 212A™ Data Sets. A standard Bell System telephone set series 500, or its equivalent, is used to manually originate and answer calls on an RJ11C service. Optionally, an RJ41S or RJ45S data service can be used.

The DF112 modem can be used for both voice and data communications with a standard telephone by using the front panel DATA/TALK (D/T) switch. To establish communications between a remote location and a local data terminal, the DF112 automatic dial feature automatically dials the number desired and establishes communications using serial binary data supplied through the EIA interface. The auto dial feature is explained in Section 3.4.

1.3 PHYSICAL DESCRIPTION

The standalone modem contains the electronics (one DF112-AM modem module) to provide one channel of data communications while the multiple modem enclosure is capable of holding up to twelve DF112-AM modem modules. In fact, the multiple modem enclosure may contain a mixture of Digital Equipment Corporation's new compatible modem modules. For example, it may contain 4 DF03-RAs, 4 DF03-RCs and 4 DF112-AMs or any compatible module combination. Printed circuit boards for both the standalone and multiple modem enclosures are identical, and are interchangeable.

103J™ and 212J™ are trademarks of Western Electric.

1.3.1 Standalone DF112-AA

The standalone DF112-AA modem (Figure 1-2) consists of a modem module (DF112-AM), mounted in a desk top enclosure (DF100-DT). Both the modem module and enclosure are field replaceable units (FRU). The enclosure includes an integral power supply, a rear cover containing line fuse, line filter and telephone line connectors, and a front cover which provides access to eight Light-Emitting Diodes indicators (LEDs) and six pushbuttons switches. The LEDs are used to determine modem status, while the pushbuttons are used to select different modes of operation and implement a variety of test features to verify proper modem operation.

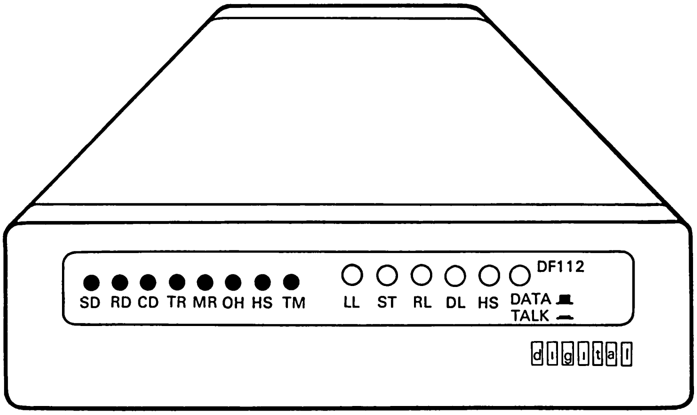


Figure 1-2 Standalone DF112 Modem

Notice that the switches and LEDs on the DF112-AA are arranged in a horizontal position. When the DF112-AM modem module is installed in the DF100-RM multiple modem enclosure it is mounted so that the switches and LEDs are in a vertical position.

The DF112-AA Standalone modem consists of:

- DF100-DT – Desk top enclosure, including intergral power supply;
- DF112-AM – DF112 modem module.

1.3.2 Multiple Modem Configuration

When mounted in the multiple modem enclosure, the DF112-AM modem module (Figure 1-3) contains all of the functionality of the standalone modem plus the advantage of lower cost because the modem modules share a common enclosure and common power supply.

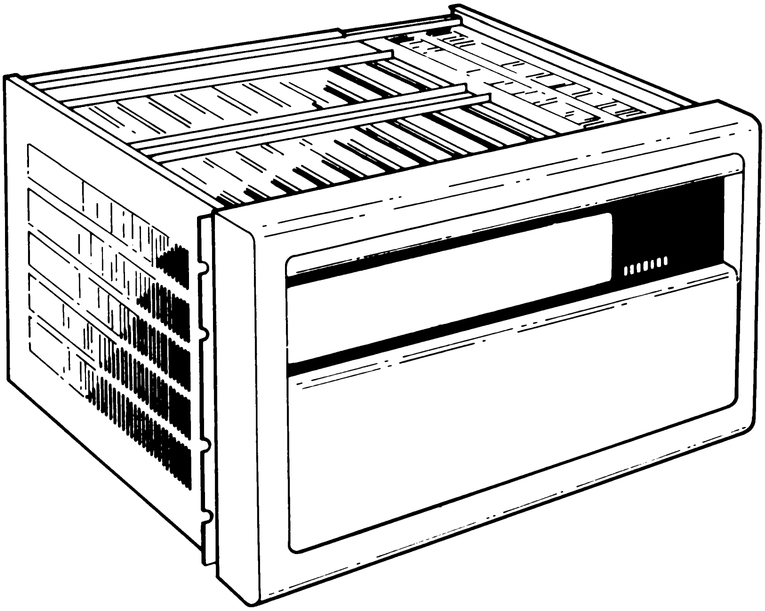


Figure 1-3 The DF100-RM Multiple Modem Enclosure

The multiple modem enclosure, with internal power supply, is called the DF100-RM. The DF100-RM enclosure fits in any standard 48.26 cm (19 in) rack cabinet.

The DF100-RM also houses an optional power regulator module called the DF100-PR. Should the primary regulator fail, the redundant power regulator automatically takes over the power load without disrupting on-line users. Notification of a power regulator failure is indicated when any of the four LEDs on the regulator module is OFF.

The power regulators provide both short circuit and overvoltage protection circuits. If (for any reason) one of the outputs is shorted or the voltage increases beyond tolerance, the system shuts down. All power supply LEDs, except for POWER STATUS, will be OFF. Once the condition is corrected, the regulator(s) can be reset by placing the ON/OFF power switch to the OFF position, then back to the ON position.

Products available for multiple modem DF112 configurations are:

- DF100-RM – Multiple modem enclosure, including integral power supply;
- DF100-PR – Optional redundant power regulator module for DF100-RM; and
- DF112-AM – DF112 modem module.

1.4 FEATURE SUMMARY

The following features are available with the DF112 modem family.

1.4.1 Dual Speed Application Modem

The DF112 modems support either 300 or 1200 b/s asynchronous or 1200 b/s synchronous applications on dial up or private/leased telephone lines.

1.4.2 FCC/DOC Approved

The DF112 modem family is FCC registered, conforms to Part 15 requirements, and is approved for direct connection to public switched telephone networks according to FCC Part 68. Also the DF112 modem family is certified by the Canadian Department of Communications (DOC) for use in Canada.

1.4.3 Packaging

The standalone DF112 modem is contained in a sturdy, compact, self-contained enclosure that is compatible with the size of a standard telephone (this allows the phone to be placed on top of the modem). The multiple modem enclosure is a space saver (requires 267mm [10.5 in] of vertical rack space) that accommodates up to 12 modem modules. Both enclosures use convection cooling for quiet operation. Both enclosues connect to either the Public Switched Telephone Network (PSTN) or to the private/leased telephone network (PLTN) on a line-by- line basis. The DF112 modem meets UL and CSA safety requirements.

1.4.4 Configuration

The DF112 modem family provides the user with the ability to modify a variety of modem configuration options by changing switches located on the module. This allows the user to quickly adapt to a wide range of communication applications without added cost. The DF112 modem can be used for both voice and data communications with a standard telephone by using the front panel DATA/TALK (D/T) switch.

The DF112 modem family also supports cabling distances up to 61 m (200 ft), four times the standard EIA RS-232-C distance of 15.25 m (50 ft).

1.4.5 Installation and Service

Installation is quick and easy; just a few cables and the DF112 modem is ready. Modem modules plug directly into enclosures without disrupting existing power or cabling. All of the DIGITAL modem products are backed by Digital Equipment Corporation's worldwide service network. DIGITAL field service offers a variety of on-site and off-site maintenance programs.

1.5 GENERAL SPECIFICATIONS

Specifications for the DF112-AM module, and the standalone and multiple modem enclosures are listed below.

1.5.1 DF112-AM Modem Module

Data Rate		
	Low Speed	0 to 300 b/s asynchronous format
	High Speed	1200 b/s +1% to −2.5% asynchronous character format 1200 b/s synchronous format
Modulation		
	Low Speed	Frequency shift keying (FSK)
	High Speed	Quaternary differential phase shift keying (QDPSK)
Format		
	Low Speed	Asynchronous 9 or 10 bit ASCII characters
	High Speed	Character asynchronous or bit synchronous binary stream data.
Mode		2 wire Public Switched Telephone Network (PSTN) or 2 wire Private Leased Telephone Network (P/LTN).

Interface	EIA RS-232-C/RS-423-A compatible voltages. Distance up to 61m (200 ft)
Interface Cables	BC22E, BC22F orBCC04 or equivalent for Asynchronous operation. BC22F or BCC04 or equivalent for Synchronous operation.
Signal Detect	
TURN ON	155 ms (±50 ms after receiving line signal)
TURN OFF	17 ms (±7 ms after loss of line signal)
Operating Temperature	10°C to 40°C (50°F to 104°F) Free air (normal convection)
Storage Temperature	-40 C to +66 C (-40 F to +150 F)
Relative Humidity	10% to 90% noncondensing, noncaustic.
Module Size	Standard grid finger board 264.2 mm × 203 mm (10.4 in × 8 in).
Module Weight	0.680 kg (1.5 lbs)
DC Power Requirements	+5Vdc @ 0.210 Amps Max. +12Vdc @ 0.125 Amps Max. −12Vdc @ 0.120 Amps Max.

1.5.2 Standalone Modem Enclosure

Height	74 mm (2.91 in)
Width	217 mm (8.56 in)
Length	292 mm (11.5 in)
Weight	2.62 kg (5 lbs, 12.5 ozs)
AC Input Power	120 Vac, 60 Hz (nominal) Operates at an input between 104 to 128 Vrms at 57 to 63 Hz with a maximum input

current of 150 mA at 128 Vac. The input power is 19.2 VA. The primary input is protected by an externally accessable 0.5 A fuse.

1.5.3 Multiple Modem Enclosure

Height	267 mm (10.5 in)
Width	483 mm (19.0 in) standard rack size
Depth	343 mm (13.5 in) card cage assembly
Weight	12.25 kg (27 lb) without modem modules or optional power regulator. Add 0.680 kg (1.5 lbs) for each DF112-AM Module and 0.907 kg (2.0 lbs) for the optional DF100-PR power regulator.
AC Input Power	120 Vac, 60 Hz (nominal) Operates at an input between 105 to 128 Vrms at 57 to 63 Hz with a maximum input current of 700 mA at 115 Vac (approximately 40 mA for each modem module and 210 mA for the power regulator). Input is protected by a 2.5A circuit breaker.
Power Supply DC Output	+5 Vdc 6.0 Amps Max +12 Vdc 2.8 Amps Max -12 Vdc 2.8 Amps Max

NOTE

The +5 Vdc output current for multiple modem enclosures below serial number (SN) 2000 is 3.0 Amps maximum, while enclosures with SN2000 and above are capable of 6.0 Amps maximum.

WARNING

If the total +5 Vdc current requirements for any combination of new modular modem modules exceed stated maximums, the circuit breaker will activate, removing power from the enclosure.

Module Capacity	3.0 Amp Enclosure = 12 DF112 modules max. 6.0 Amp Enclosure = 12 DF112 modules max.
DF100-PR Redundant Power Regulator Module	
Size	203 mm × 158.7 mm (8 in × 6.25 in) including the heat sink.
Weight	0.907 kg (2.0 lbs)

1.5.4 Auto Dial Unit

The Automatic Dial feature is implemented on a single Integrated Circuit (IC) chip. These features are summarized here and detailed in Section 3.4.

- Compatible with both Touch Tone™ and rotary pulse dialing techniques.
- Provides numerous commands to control a variety of functions.
- Operates in both intractive mode or burst mode.
- Capable of storing 5 (26 digit) numbers (4 numbers plus the current number).

Other characteristics associated with auto dial are:

Data Rate	Supports 300 or 1200 b/s asynchronous ASCII data format.
Commands	Control B (CTRL/B) = Activates and resets interactive mode auto dial function. Control A (CTRL/A) = Activates burst mode auto dial function.

Touch Tone™ is a trademark of AT&T

Control C (CTRL/C) = In manual answer mode, connects to the line if the DATA/TALK switch is in the DATA position. If the TR indicator is ON, pressing control C places modem OFF HOOK.

T = Indicates that the digits that follow are to be dialed as touch tone.

P = Indicate that the digits that follow use pulse dialing.

# = Indicates the end of the number sequence; start dialing.

Equal Sign (=) = Access pause – Causes a pause period of 15 seconds to wait for secondary dial tone. If a dial tone is not detected within 15 seconds, the auto dialer responds with the NO DIAL TONE message.

Dial Tone Abort	Aborts call if dial tone is not detected within 15 seconds after initiating a call.
Answer Tone Abort	Aborts call if dial tone is not detected within 30 seconds after initiating a call.

CHAPTER 2
SITE PREPARATION AND INSTALLATION

2.1 GENERAL

The DF112 modem is approved by the U.S. Federal Communications Commission (FCC) for direct connection to the telephone network. The DF112 is also certified by the Department of Communications (DOC) for Canadian use. Regulatory requirements outlined in Section 2.2 must be observed before and during installation of the DF112 Modem.

2.2 REGULATORY AGENCY REQUIREMENTS

Government controlled communication regulatory agencies require that devices (such as modems) attaching to telephone lines must comply with certain regulations concerning use of standard plugs and jacks, as well as other operational and protective requirements.

Prior to installation, it is necessary to contact the local telephone business office and request data communications service for installation of customer-provided equipment. Generally, the type of information required is:

- Type of communication service required to support customer provided equipment:
  - Public Switched Telephone Network (PSTN) or;
  - Private Leased Telephone Network (P/LTN)
- Number of telephone circuits (lines) required with service.
- FCC registration or DOC certification number and the ringer equivalence number.

For specific information, refer to Section 2.2.1 for US installations and to Section 2.2.2 for Canadian installations.

2.2.1 FCC Regulations

2.2.1.1 FCC Part 68-Direct Connection--The chart below contains FCC information on the DF112 that must be given to the local telephone company when telephone service is requested for U.S. installations. The FCC control number for part 68 assigned to the DF112 modem is A0994Q-13634-DM-E.

U.S. Installations

Topic	Standalone DF112 Modem Enclosure	Multiple DF112 Modem Enclosure
FCC Registration Number	AO994Q-13634-DM-E	AO994Q-13634-DM-E
Ringer Equivalence Number	0.3B	0.3B
Type of Service	1) Single switched line with either RJ11C, RJ41S or RJ45S service	1) Up to 12 public switched lines terminated in RJ21X connector block
	2) Single (2 wire) private leased line service terminated in a 625 type conntion block or 6 position wall jack	2) Up to 12 private leased line service
		3) A combination of 1 and 2 above not exceeding 12

NOTE

When installing a multiple modem enclosure, an interconnecting cable is required to attach the enclosure to the RJ21X service. This cable may be supplied by the telephone company. If the telephone company does not supply this cable with the service, then the cable must be ordered. The correct cable type is a Western Electric B25A™ cable or equivalent. Contact the local DIGITAL office for ordering information. Careful consideration must be given to the location of the multiple modem enclosure. For details see Section 2.5.2.

2.2.1.2 FCC Part 15J (RFI/EMI) Verification for DF112-AA – The DF112-AA standalone modem generates and uses radio frequency energy. If this equipment is not installed and used in strict accordance with the instructions in this manual, it may cause interference with radio and television reception. The DF112-AA complies with the limits for a Class B computing device according to Part 15, Subpart J, of the FCC rules. These rules are designed to provide reasonable protection against interference when operated in a residential environment. If this equipment does cause interference with radio or television reception, determined by turning the equipment OFF and ON, the user is encouraged to correct the problem by trying one or more of the following measures. The FCC control number for category B assigned to the DF112-AA modem is AO994Q-DF100.

- Reorient the receiving antenna.
- Move the equipment around or away from the receiver.
- Plug the equipment into a different outlet so that the equipment and receiver are on different branch circuits.

If the above measures fail, the user should consult a dealer or an experienced radio/television technician. *How to Identify and Resolve Radio-TV Interference Problems*, a booklet prepared by the FCC, is also recommended. This booklet is obtainable from the US Government Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4.

B25A™ is a trademark of Western Electric.

2.2.1.3 FCC Part 15J (RFI/EMI) Verification for DF112-AM - The DF112-AM modem module generates and uses radio frequency energy. If this equipment is not installed and used in strict accordance with the instructions in this manual, it may cause interference with radio and television reception. The DF112-AM module is verified to comply with the limits for a Class A computing device according to Part 15, Subpart J, of the FCC rules when tested in the multiple modem enclosure. These rules are designed to provide reasonable protection against interference when operated in a commercial environment.

2.2.2 DOC Regulations

The chart below contains DOC information that must be given to the telephone company when telephone service is requested for Canadian installations.

Canadian Installations

Topic	Standalone DF112 Modem Enclosure	Multiple DF112 Modem Enclosure
DOC Certification Number	192 859 AB	192 859 AB
Type of Service	1) Single switched line with either CA11A, CA41A or CA45A service	1) Up to 12 public switched lines terminated in CA21A connector block
	2) Single (2 wire) private leased line service terminated in a 6 position modular wall jack or equivalent	2) Up to 12 private leased line service
		3) A combination of 1 and 2 above not exceeding 12

NOTE

When installing a multiple modem enclosure, an interconnecting cable is required to attach the enclosure to the CA21A service. This cable may be supplied by the telephone company. If the telephone company does not supply this cable with the service, then the cable must be ordered. The correct cable type is a Western Electric B25A™ cable or equivalent. Contact the local DIGITAL office for ordering information. Careful consideration must be given to the location of the multiple modem enclosure. For details see Section 2.5.2.

2.3 OPERATING ENVIRONMENT

2.3.1 Standalone DF112 Modem

The standalone DF112 modem operates within temperatures ranging from 10°C to 40°C (50°F to 104°F) and a relative humidity ranging from 10% to 90% noncondensing. Normal air convection is sufficient for cooling. Nominal power required is 17.0 volt amperes at 120 volts, 60 Hz. The power supply withstands input

voltage changes ranging from 105 Vac to 128 Vac. The input line frequency can change from 57 Hz to 63 Hz without having an effect on the operation of the standalone modem.

2.3.2 Multiple DF112 Modem Configurations

The operating environment for multiple DF112 modem configurations is basically the same as the standalone modem except for the following.

The normal power required for a fully configured multiple modem enclosure (DF100-RM) with DF112 modems, is about 21 volt amperes at 120 volts, 60 Hz. Each DF112 modem module adds about 42 milliamperes of current to the ac line load.

The maximum power allowed for a fully configured DF100-RM, is about 150 volt amperes at 120 volts, 60 Hz.

The maximum output of the enclosure's +5 Vdc power supply must be considered when installing a variety of the new modular modems, including the DF112. The maximum +5 Vdc current available from multiple modem enclosures below serial number (SN) 2000 is 3.0 Amps. For enclosures above SN 2000, the maximum +5 Vdc current is 6.0 Amps.

CAUTION

When installing different modems with different +5 Vdc current requirements the total current of all the modem modules must not exceed rated maximums of the enclosure power supply.

Refer to the specific user's guide for +5 Vdc current requirements of the modem module. For example, the DF112 module requires 0.210 Amps of +5 Vdc current. This means that the maximum of 12 DF112s can be installed in both the earlier enclosures and the newer enclosures.

NOTE

Earlier enclosures (below SN 2000) can be upgraded to 6 Amp capacity by changing the backplane to REV C or above and changing the power regulator module to REV E or above.

2.4 UNPACKING AND INSPECTION

Components for the DF112-AA Standalone modem (DF100-DT enclosure and DF112-AM modem module) are indiviually packaged in cardboard containers and shipped together in one larger container. The unpacking procedure is detailed below:

1. Open the container and remove all packing material, two smaller containers and the current copy of the user's guide.

   NOTE

   Inspect each piece for damage as it is removed from the carton. Also check each piece against the shipping list.

2. Open box marked DF100-DT and remove the standalone modem enclosure, power cord and telephone extension cable. Place items to one side.

3. Open box marked DF112-AM and remove the modem module and the standalone enclosure front panel stick-on window.

NOTE

Modem modules that are ordered separately for multiple modem enclosure installations are shipped in the same containers with a stick-on window. The stick-on window is not used on multiple modem enclosures.

4. Inspect cables, plugs, and connectors for bent pins, crushed wires, and damaged components.

5. Check the carton for small parts that may have fallen off as a result of rough handling. Any damage to the unit should be reported to the shipper and Digital Equipment Corporation at once. Any shortages in package inventory should be reported by calling the original sales office.

2.5 INSTALLATION

This section describes the installation procedure for both the standalone modem and multiple modem configurations. The site preparation cosiderations are: compliance with environmental specifications and ordering the correct telephone service.

The standalone modem enclosure may be placed in a convenient location (shelf, desk top, and so on) so that it conforms to the maximum cabling distances and it is in easy access to ac power.

The multiple modem enclosure may be placed in the DIGITAL H9646 Communications cabinet or any other standard 48.26 cm (19 in) cabinet and must be in easy access to ac power. Do not place either unit in or near electrically noisy equipment thus violating Part 15 of the FCC rules.

NOTE

The DF112-AM modem module is factory configured for compatibility with most data communications equipment. However, in some cases it may be necessary to select different options. For option selection guidelines, see Chapter 5.

2.5.1 Standalone DF112-AA Installation

Since the DF100-DT and DF112-AM are shipped individually packaged, the modem module must be installed into the standalone enclosure before connecting to the network. To insert the module in the enclosure, follow the procedure below:

2.5.1.1 Installing Standalone Modem Modules

1. Before removing the front cover on the standalone enclosure to install the modem module, place the stick-on window in the recessed area of the cover to verify that the holes for the pushbutton switches line up. Then peel the backing from the window and place it permanently.

2. From the bottom, remove the two slotted screws closest to the front cover as shown Figure 2-1 and remove the cover.

   NOTE

   Before installing the module be sure to verify that the switchable option selections are correctly configured for the desired options, see Chapter 5.

3. With the enclosure up-side-down, insert the modem module (components facing down) into the card guides on each side of the DF100-DT enclosure. Slide the module in until it touches the backplane mating connector. Then press firmly until the module snaps into the rear mating connector.

4. Replace the front cover on the enclosure and secure with the two screws removed in Step 2.

Procedures for installing the standalone modem to the public switched telephone network vary, depending on the type of service that is requested and installed by the telephone company. Three type of service connections are possible and are explained in detail below:

1. Connected to RJ11C (US) or CA11A (CAN) service;

2. Connected to RJ41S/RJ45S (US) or CA41A/CA45A (CAN) exclusion key service or;

3. Connected to private/leased line.

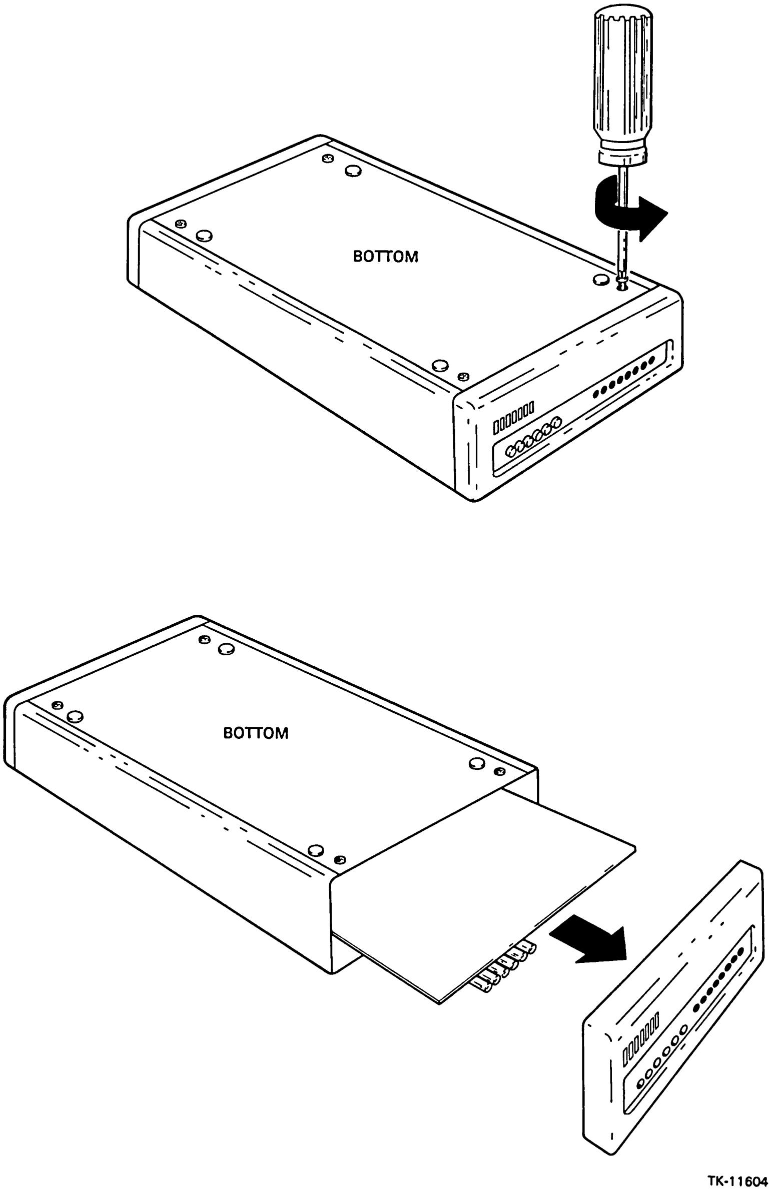


Figure 2-1 Standalone Modem Front Cover Removal

2.5.1.2 Installing the Standalone Modem to RJ11C (CA11A) Service – RJ11C or equivalent service is supplied on a 6 position miniature jack. DF112 rear panel connections for the telephone line and handset are 8 position miniature jacks (see Figure 2-2). Standard 6 position plugs will connect to 8 position jacks. It is important however, that 6 position plugs be centered in the 8 position jack when the connection is made. Do not insert the 6 position plug into the 8 position jack at an angle. Refer to Figure 2-3 for the following installation procedure.

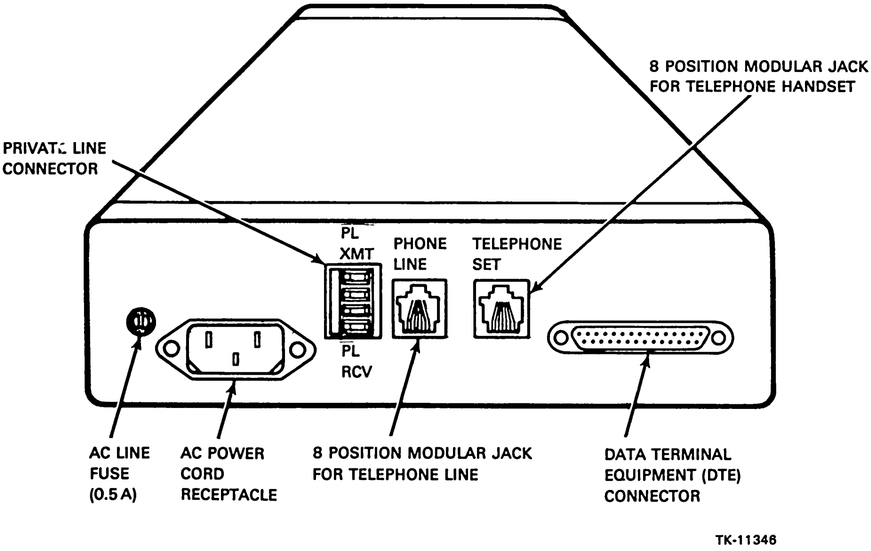

8 POSITION MODULAR JACK FOR TELEPHONE HANDSET
PRIVATE LINE CONNECTOR
PL XMT
PHONE LINE
TELEPHONE SET
PL RCV
AC LINE FUSE (0.5 A)
AC POWER CORD RECEPTACLE
8 POSITION MODULAR JACK FOR TELEPHONE LINE
DATA TERMINAL EQUIPMENT (DTE) CONNECTOR
TK-11346

Figure 2-2 Standalone Modem Rear Connector Panel

① Unplug telephone from wall box.

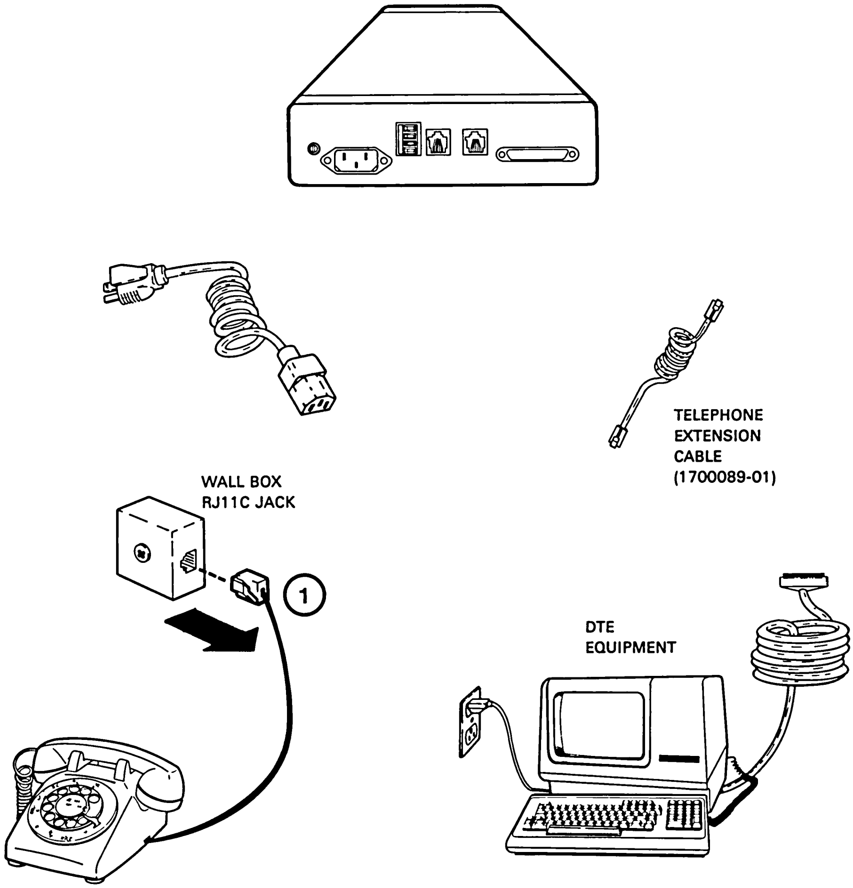


Figure 2-3 Installing Standalone Modems On RJ11C or Equivalent Service (Sheet 1 of 4)

② Plug the telephone into the right-hand 8 position jack on the modem.

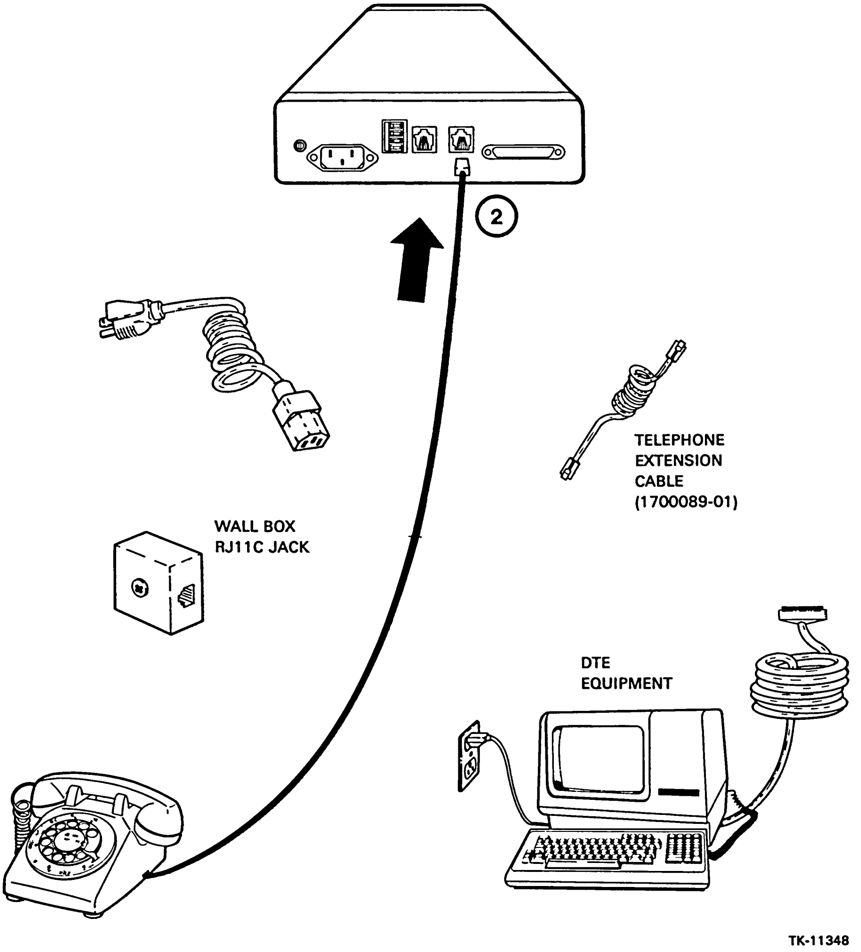


Figure 2-3 Installing Standalone Modems On RJ11C or Equivalent Service (Sheet 2 of 4)

③ Plug one end of the 4-wire telephone extension cable (1700089-01) into the left-hand 8 position jack on the modem. Plug the other end into the wall box.

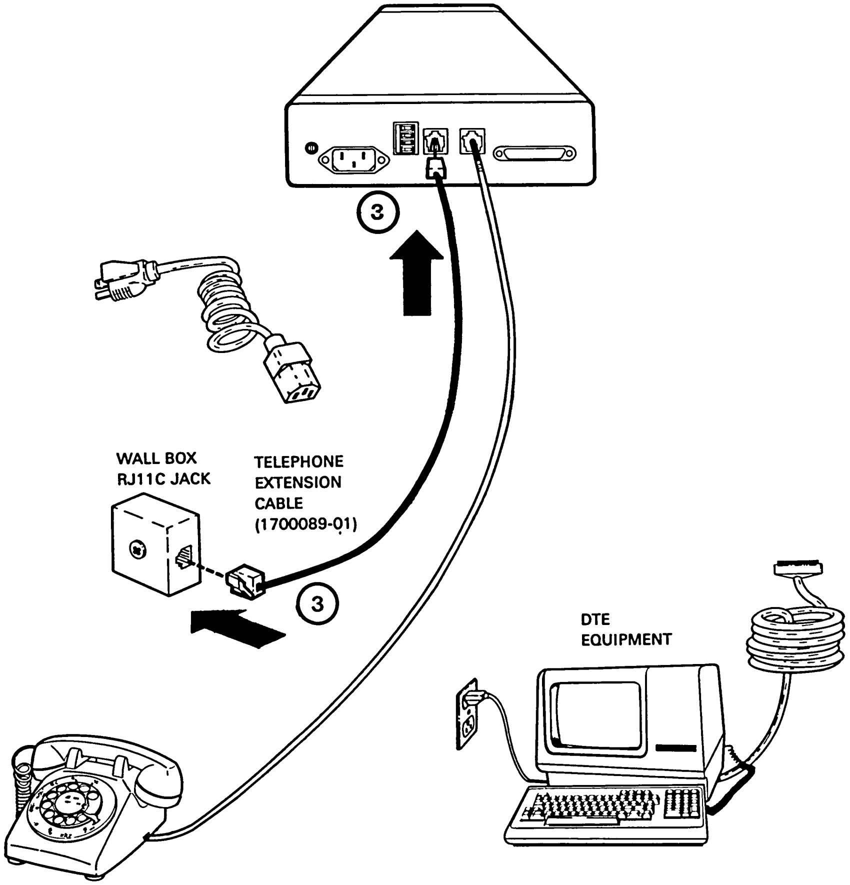


Figure 2-3 Installing Standalone Modems On RJ11C or Equivalent Service (Sheet 3 of 4)

④ Plug terminal cable (or other DTE device) into the modem DTE interface connector.

⑤ Plug the power cord into the rear of the modem, then into the ac wall outlet.

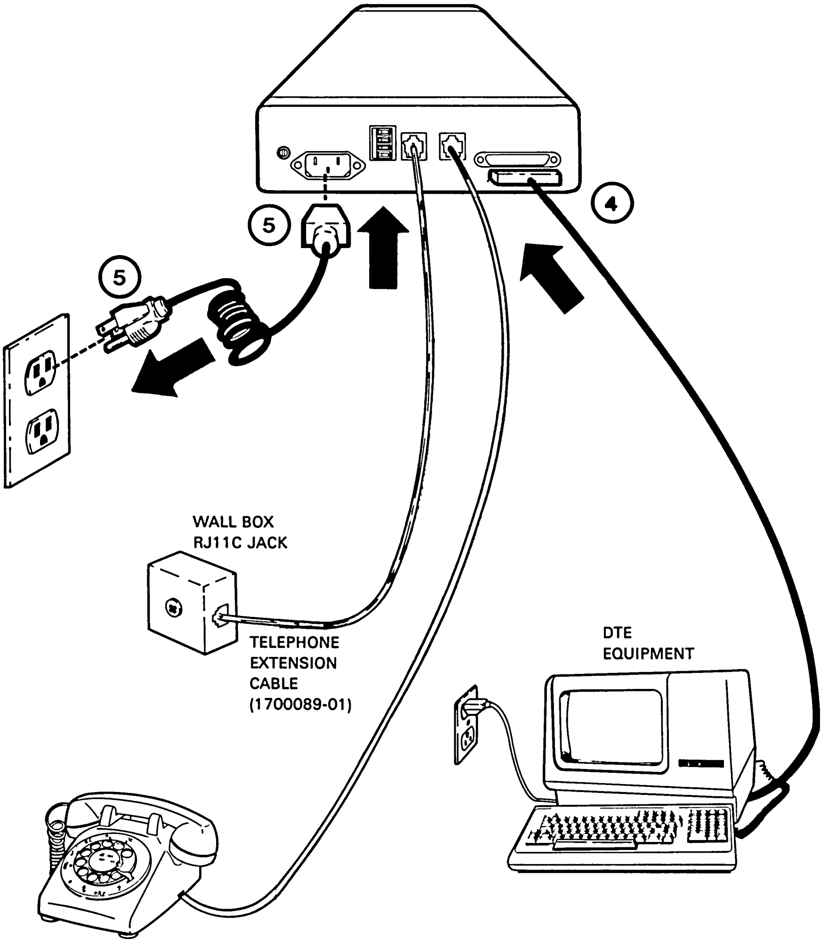


Figure 2-3 Installing Standalone Modems On RJ11C or Equivalent Service (Sheet 4 of 4)

1. Unplug telephone from wall box.

2. Plug the telephone into the right-hand 8 position jack on the rear panel of the modem.

3. Plug one end of the 4-wire telephone extension cable (1700089-01) into the left-hand 8 position jack on the rear panel of the modem. Plug the other end into the wall box.

4. Plug terminal cable (or other DTE device) into the modem DTE interface connector.

5. Plug the power cord into the rear of the modem, then into the ac wall outlet.

2.5.1.3 Installing the Standalone Modem To RJ41S/RJ45S (CA41A/CA45A) Service – When exclusion key telephone service is used, no connection is needed at the right-hand 8 position jack on the rear of the modem. Refer to Figure 2-4 for the following installation procedure.

NOTE

1. **To enable exclusion key functions, the MI DISABLE option (switchpack 3, switch S5) must be enabled.**

2. **If programmed service is installed, the programmed transmit level option (switchpack 2, switch S10) must be set to enabled and the normal level option (switch S9) disabled (see Chapter 5). Also, an 8-wire telephone extension cable (not supplied) such as MOD TAP 558-015 or Virginia Plastics 105-KK-15DS-SW or equivalent must be used in place of the standard 4-wire (1700089-01) cable supplied.**

① Plug one end of the telephone extension cable into the RJ41S or RJ45S (or equivalent) wall box. Plug the other cable end into the left-hand 8 position jack on the rear of the modem.

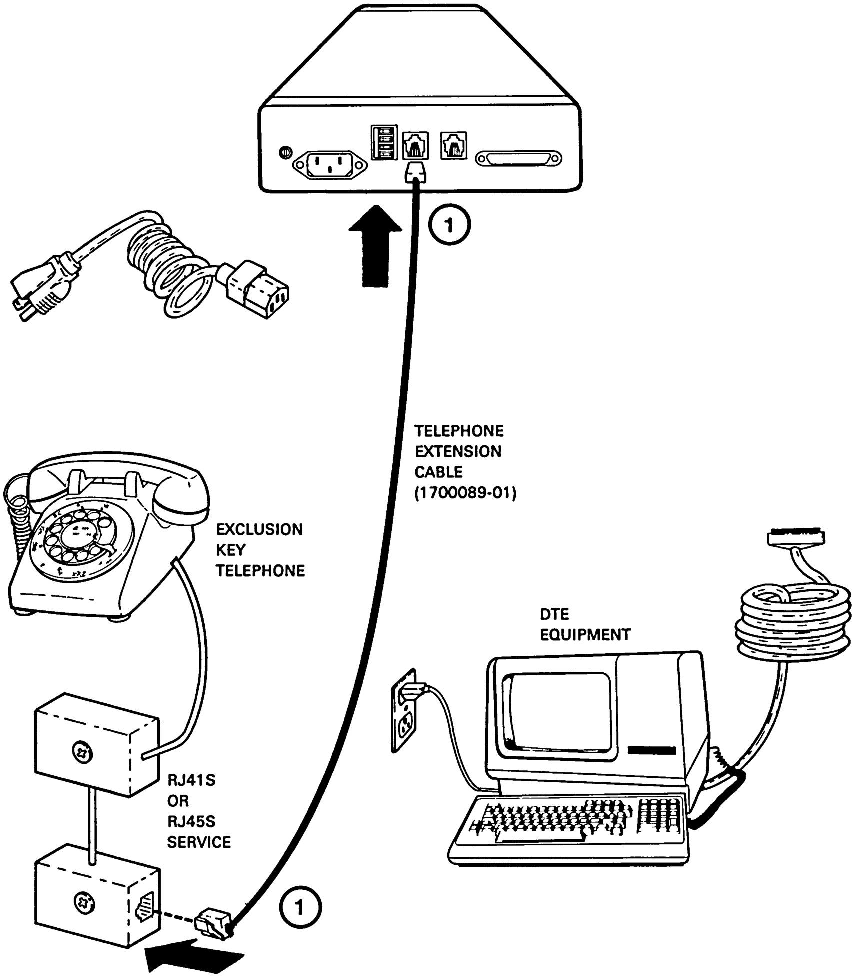


Figure 2-4 Installing Standalone Modems On RJ41S/RJ45S or Equivalent Service (Sheet 1 of 2)

② Plug terminal cable (or other DTE device) into the modem DTE interface connector.

③ Plug the power cord into the rear of the modem, then into the ac wall outlet.

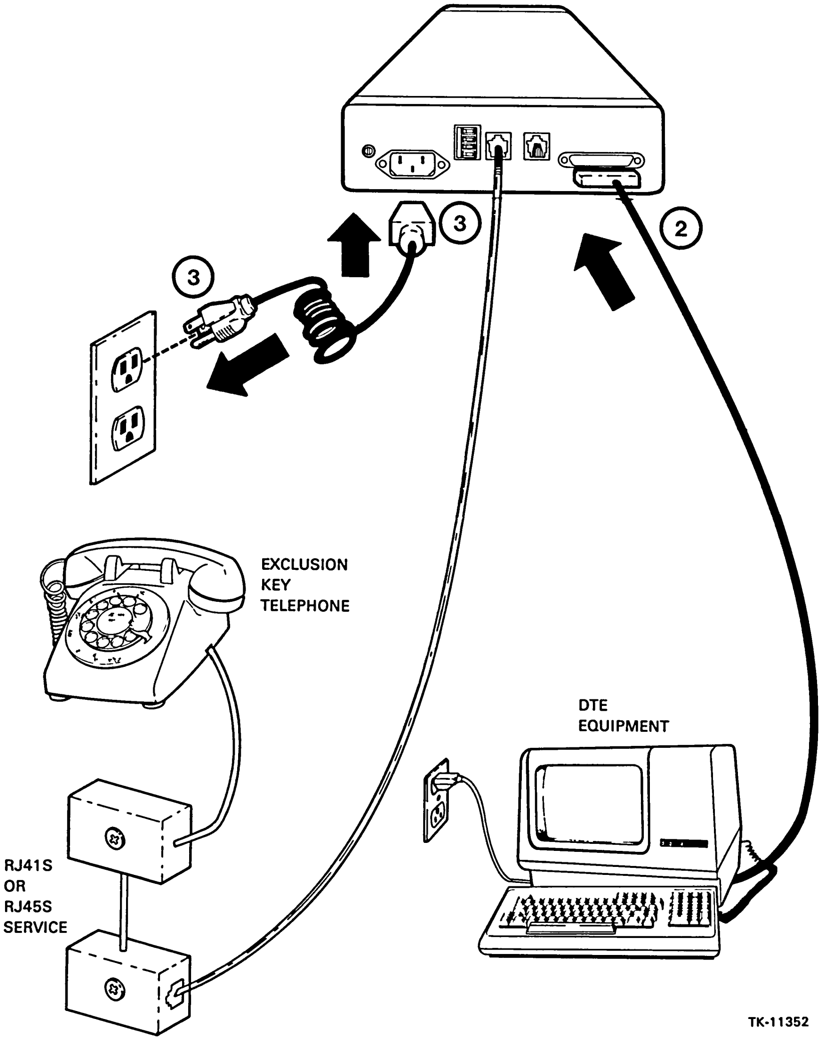


Figure 2-4 Installing Standalone Modems On RJ41S/RJ45S or Equivalent Service (Sheet 2 of 2)

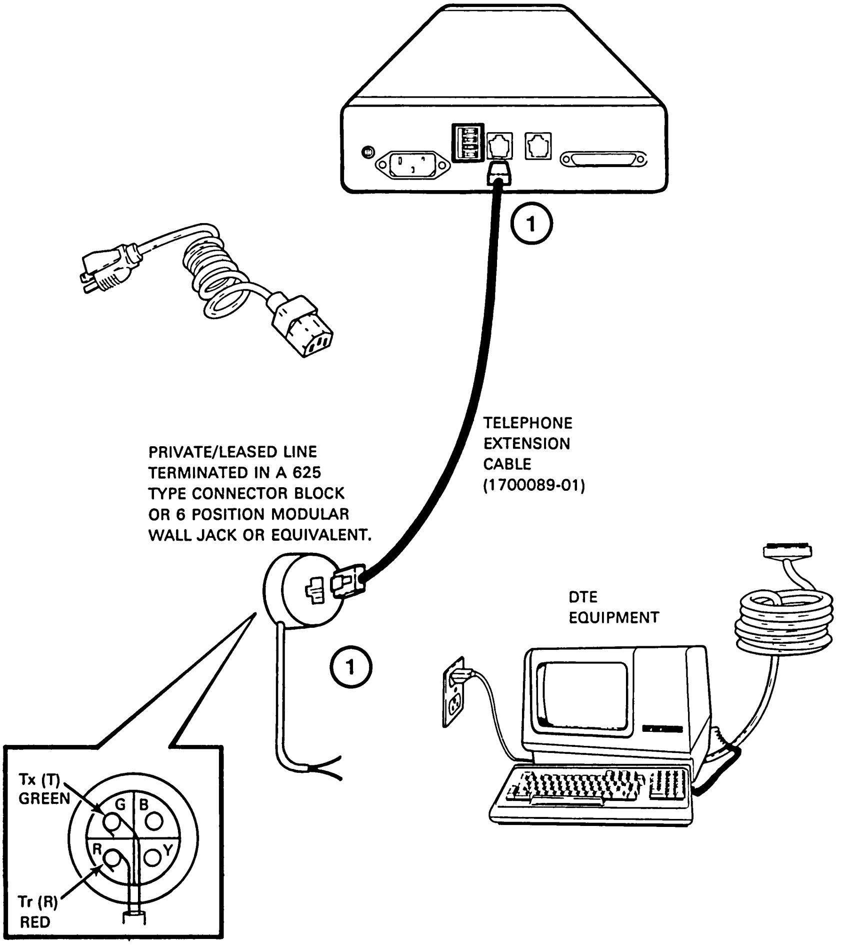
1. Plug one end of the telephone extension cable into the RJ41S or RJ45S (or equivalent) wall box. Plug the other cable end into the left-hand 8 position jack on the rear of the modem.
2. Plug terminal cable (or other DTE device) into the modem DTE interface connector.
3. Plug the power cord into the rear of the modem, then into the ac wall outlet.

Using the modem with exclusion key telephone (MI enabled) for a period of time, then at a later date moving the modem to a different service without disabling the MI option could cause a continuous OFF HOOK condition. Be sure to check the MI option when the modem is being changed between different types of service.

2.5.1.4 Installing the Standalone Modem To Private Line Service – DF112 private line applications is a special added feature which is NOT found on other compatible modems. The normal private/leased line (PL) connector on the rear of the standalone modem enclosure is not used for DF112 private line connections. The detachable private line connecter, however, is used on all of Digital's other new modular modem products.

Private line connections for the DF112 standalone modem are made by connecting the standard telephone extension cable (1700089-01) between the left-hand, 8 position jack (labeled PHONE LINE) on the rear of the standalone modem and the private line service. Refer to Figure 2-5 for the following installation procedure.

① Connect one end of the telephone extension cable to the left-hand 8 position jack on the rear of the modem. Connect the other cable end to the 6 position modular wall jack or equivalent.



MKV84-0740

Figure 2-5 Installing Standalone Modems On Private lines (Sheet 1 of 2)

② Plug terminal cable (or other DTE device) into the modem DTE interface connector.

③ Plug the power cord into the rear of the modem, then into the ac wall outlet.

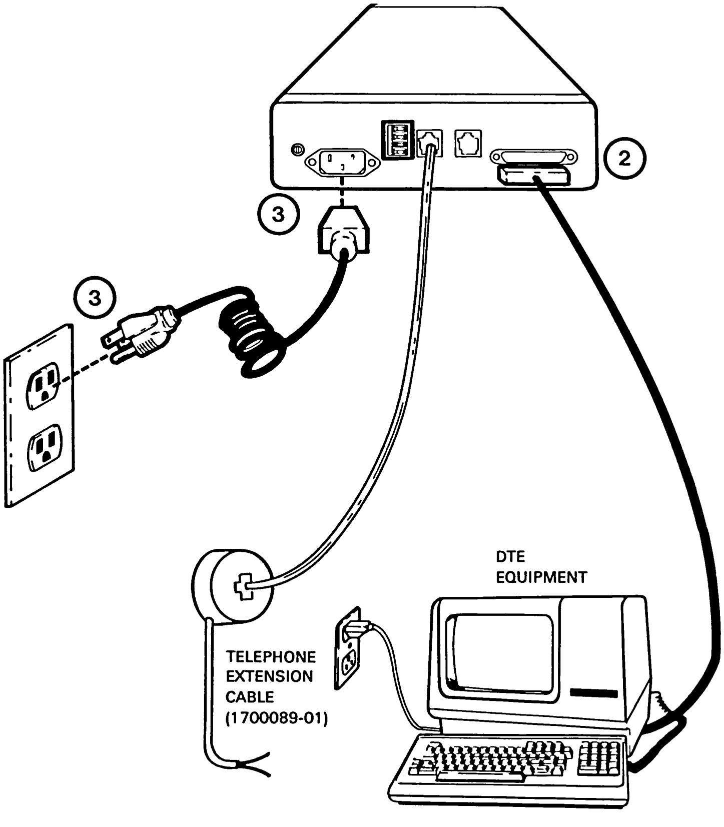


Figure 2-5 Installing Standalone Modems On Private lines (Sheet 2 of 2)

1. Connect one end of the telephone extension cable to the left-hand 8 position jack on the rear of the modem. Connect the other cable end to a 6 position modular wall jack or equivalent.

   NOTE

   If private line connections are not terminated in a 625 type connection block or compatible with a 6 position modular wall jack or equivalent, the user is responsible for making whatever adaptive connections necessary to accommodate private line connections. Refer to the insert of Figure 2-5 for private 2 wire connections.

2. Plug terminal cable (or other DTE device) into the modem DTE interface connector.

3. Plug the power cord into the rear of the modem, then into the ac wall outlet.

2.5.2 Installing the Multiple Modem Enclosure

Figure 2-6 is a rear view of the multiple modem enclosure connector panel. DTE connections are made to J1 through J12 for modem lines one through 12 respectively. Installation requires selecting a suitable rack location within cabling distances of the data terminal equipment and the RJ21X or CA21A telephone service or private/leased line connections.

NOTE

The location of the RJ21X or CA21A service is very important. When this service is being installed, make sure it is within standard cable distance, typically 5.2 m (15 ft) from the enclosure. In most installations, the RJ21X or CA21A service is installed in the cabinet that houses the enclosure.

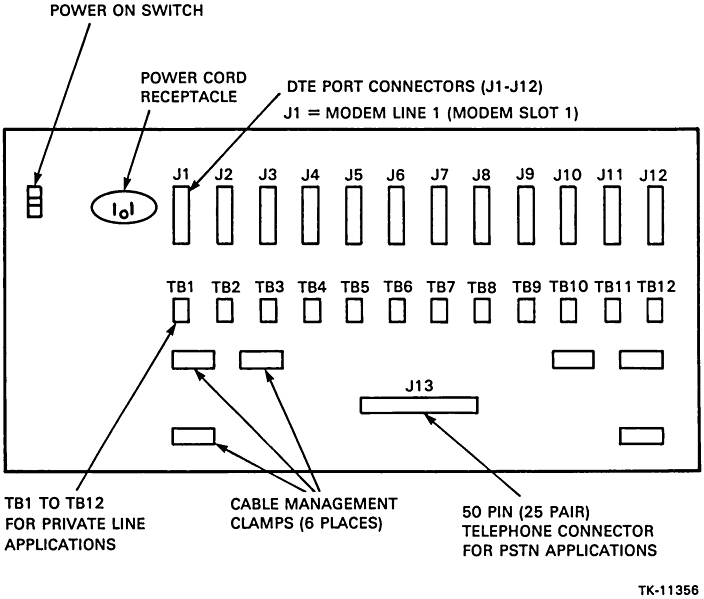

POWER ON SWITCH
POWER CORD RECEPTACLE
DTE PORT CONNECTORS (J1-J12)
J1 = MODEM LINE 1 (MODEM SLOT 1)
J1
J2
J3
J4
J5
J6
J7
J8
J9
J10
J11
J12
TB1
TB2
TB3
TB4
TB5
TB6
TB7
TB8
TB9
TB10
TB11
TB12
J13
TB1 TO TB12 FOR PRIVATE LINE APPLICATIONS
CABLE MANAGEMENT CLAMPS (6 PLACES)
50 PIN (25 PAIR) TELEPHONE CONNECTOR FOR PSTN APPLICATIONS
TK-11356

Figure 2-6 Multiple Modem Enclosure Rear Connector Panel

Once the location is selected, follow the procedure below to mount the multiple modem enclosure.

1. Remove the hinged front door by opening the door (pull at the top) and releasing the two bottom spring latches (pull handles toward the center).

2. Remove the front door panel assembly from the DF100-RM enclosure by removing four screws (two on the top flange and two on the bottom flange). Refer to Figure 2-7.

3. Remove all blank filler cards from the enclosure (Figure 2-8). Save these filler cards – DO NOT throw them away.

4. Locate the proper placement in the computer cabinet for the enclosure and mount it to the multiple position, vertical rail assembly of the cabinet. Standard rack mounting procedures must be observed. Be sure to leave about 3.18 cm (1.25 in) clearance between the enclosure

and other equipment for reassembly of the front door panel. The mounting hardware included is eight clip nuts and eight 10-32 × 1/2 screws.

5. Reinstall the front door panel assembly that was removed in Step 2.

6. Plug the power cord into the rear panel power connector (Figure 2-9) and connect the ac plug to an electrical outlet.

7. For public switched telephone connections, install the interconnecting (B25A type) cable between J13 of the DF100-RM enclosure and the RJ21X or CA21A service (see Figure 2-10). This cable is not supplied as standard equipment and must be ordered separately. Pin number/modem slot assignments for the J13 connection are detailed in Appendix C, Table C-1.

8. For private/leased line connections, make 2 wire connections to the appropriate TIP & RING pins (slot dependent) at J13 or at the RJ21X or CA21A service, if used (see Figure 2-10).

9. Once the telephone cable is connected, apply power to the enclosure and observe that all the power supply status LEDs are ON (see Figure 2-8).

10. This completes multiple modem enclosure installation. The modem modules are installed next. Refer to Section 2.5.3.

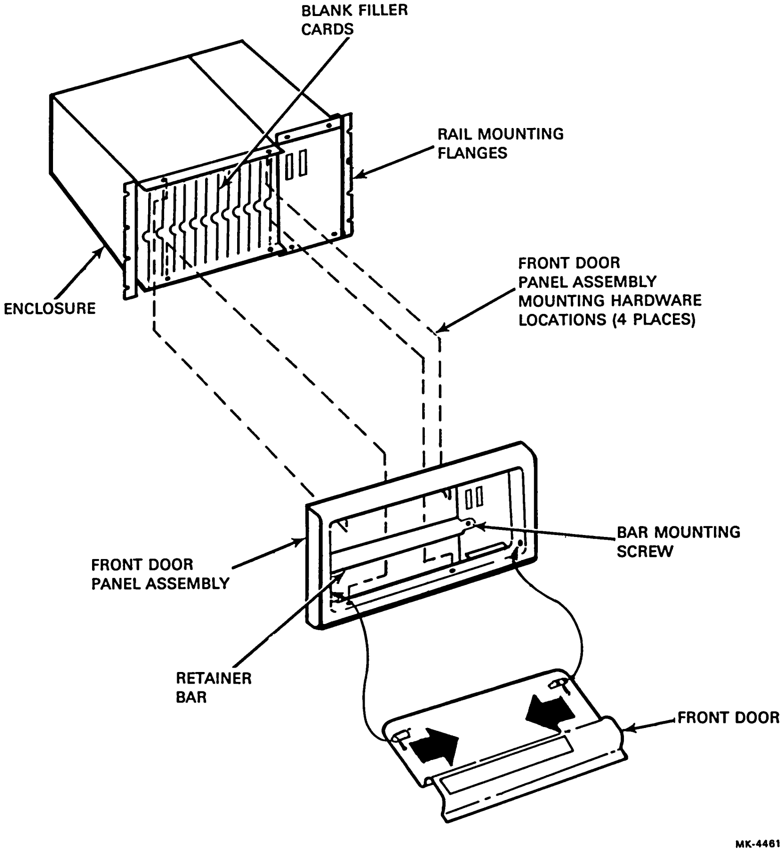


Figure 2-7 Multiple Modem Enclosure Installation Diagram

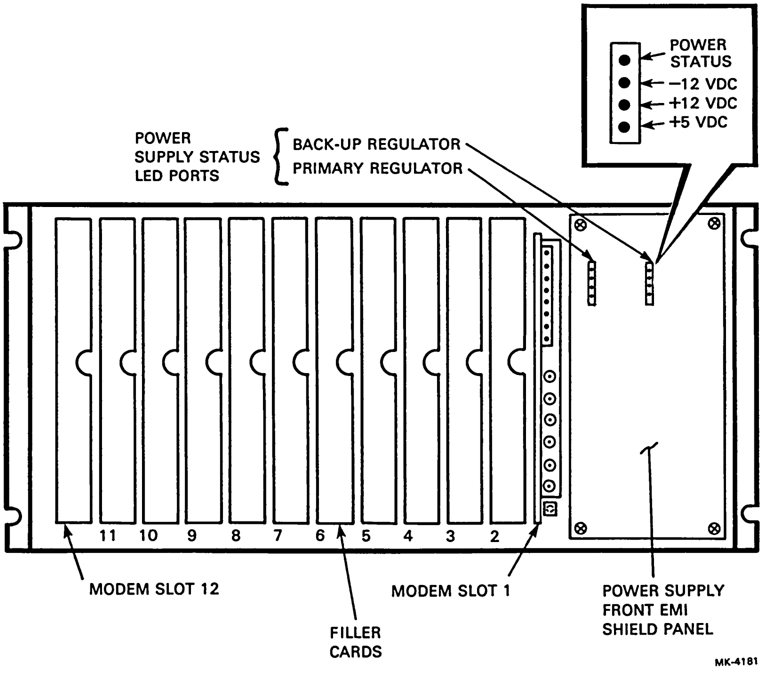


Figure 2-8 Multiple Modem Enclosure Module Placement

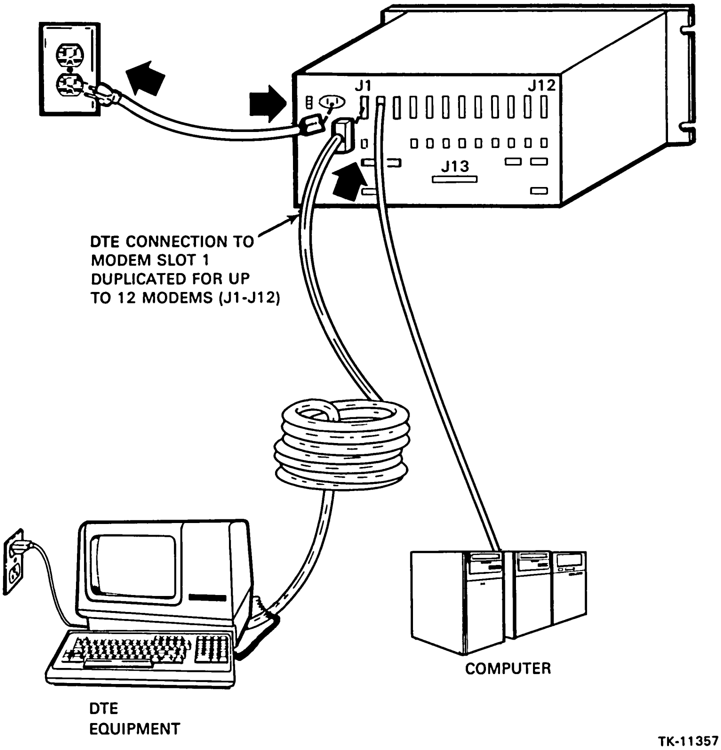

J1
J12
J13
DTE CONNECTION TO MODEM SLOT 1 DUPLICATED FOR UP TO 12 MODEMS (J1-J12)
COMPUTER
DTE EQUIPMENT
TK-11357

Figure 2-9 Multiple Modem Enclosure Interface Cabling

CONNECTOR J13 PINOUTS

LINE/ SLOT	RING	TIP
1	PIN 1	PIN 26
2	PIN 2	PIN 27
3	PIN 3	PIN 28
4	PIN 4	PIN 29
5	PIN 5	PIN 30
6	PIN 6	PIN 31
7	PIN 7	PIN 32
8	PIN 8	PIN 33
9	PIN 9	PIN 34
10	PIN 10	PIN 35
11	PIN 11	PIN 36
12	PIN 12	PIN 37

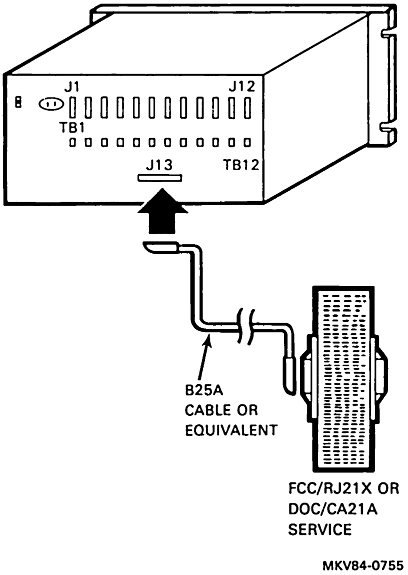


Figure 2-10 Multiple Modem Enclosure PSTN-PLTN Line Connections

2.5.3 Installing Multiple Modem Modules

To install modem modules into multiple modem enclosures, follow the procedure below.

1. Verify that each modem module is correctly configured for the desired options (see Chapter 5). Factory selections are compatible with most data communications equipment.

2. If the front door was removed earlier during the enclosure installation, go to Step 3. Otherwise, remove the hinged front door by opening the door (pull at the top) and releasing the two bottom spring latches (pull handles toward the center). The front door must be removed to either remove or insert modules (see Figure 2-7).

3. Remove the module retainer bar from front of the card cage area by unscrewing the holding screw on the right side (see Figure 2-7). Remove the other end of the bar from its retaining slot.

NOTE

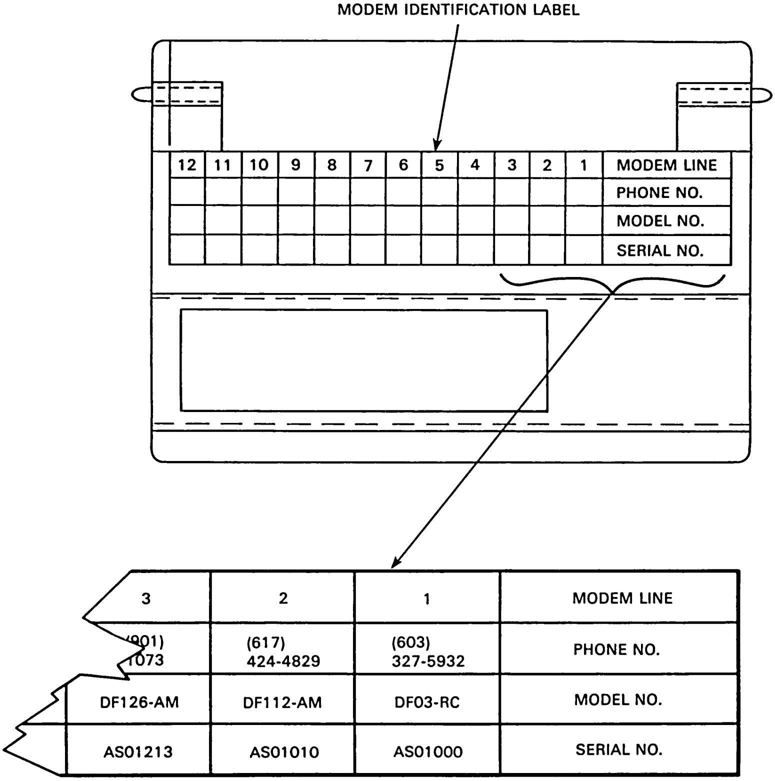
If the blank filler cards were removed earlier during the installation of the multiple modem enclosure, go to Step 4. Before installing a modem module into its assigned slot, the filler card must be removed and saved. If a modem module is permanently removed, a filler card must be inserted in its place.

4. Insert and firmly seat each modem module into the assigned slot of the enclosure. Be sure that components are facing the power supply (see Figure 2-8).

5. After installing all modules, be sure to correctly log module characteristics of each modem on the identification label located on the inside surface of the front door (see Figure 2-11). All slots must be filled with either modem modules or filler cards.

6. Connect the DTE cables for each modem line being used to the appropriate modem line, jack J1 through J12. Refer to Figure 2-9.

7. Perform the test procedures in Chapter 4 that apply to your modem configuration.



3	2	1	MODEM LINE
901) 1073	(617) 424-4829	(603) 327-5932	PHONE NO.
DF126-AM	DF112-AM	DF03-RC	MODEL NO.
AS01213	AS01010	AS01000	SERIAL NO.

Figure 2-11 Modem Identification Label

2.5.4 Installing DF100-PR Redundant Power Regulator

To install or replace the DF100-PR power regulator, both the front door panel assembly and Electromagnetic Interference (EMI) panel must be removed as described in the procedure below.

1. Remove the four front door panel mounting screws, as shown in Figure 2-12, and remove the panel assembly. Two screws are located on the top flange at point A and two are on the bottom flange at point B.

2. Remove the four EMI panel mounting screws (one at each corner) and remove panel.

3. Remove the existing power regulator module from its mounting slot and attach the interconnecting cable (part number 7019305) between the two regulator modules as shown in Figure 2-13. Be sure not to disconnect the main power cable from the transformer.

4. Insert both regulator modules, with the LEDs on top and facing out, and slide both modules to the backstop.

NOTE

Regulator modules do not plug into any type of backplane edge connector, they simply mount in each slot. Connections are made by the power cable.

5. Replace the EMI panel and the front door panel assembly. power up the enclosure and verify that all power LEDs come ON.

① Remove four front door panel mounting screws and remove panel assembly. Two screws are located on the top flange at point A and two are on the bottom flange at point B.

② Remove four EMI panel mounting screws (one at each corner) and remove panel.

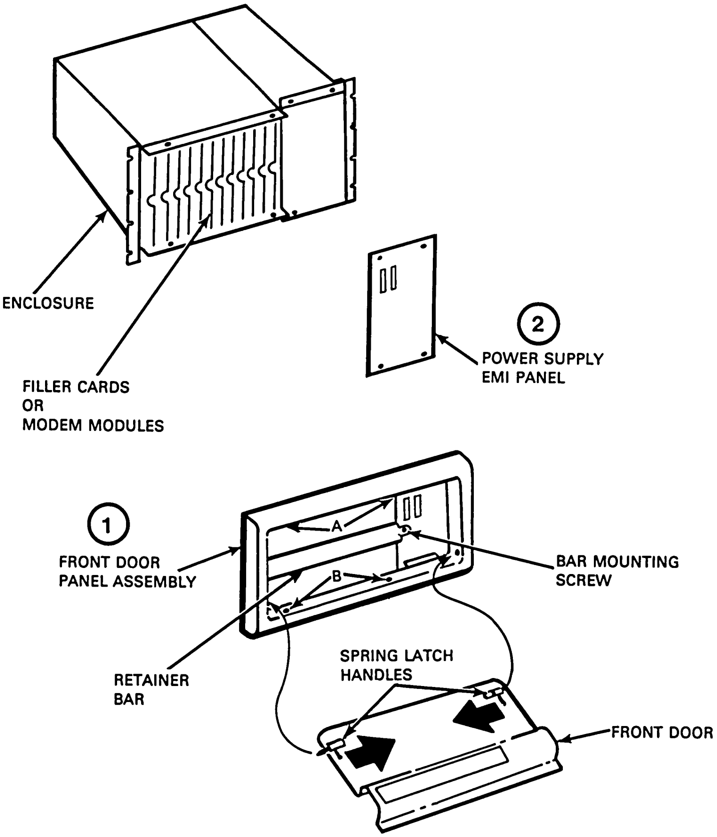


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Figure 2-12 Installing the DF100-PR Power Regulator Module

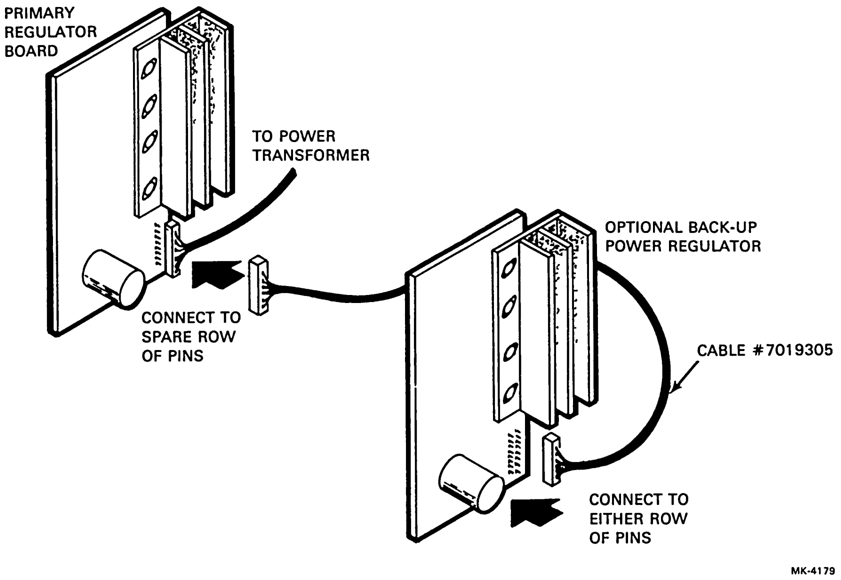


Figure 2-13 Redundant Power Regulator Interconnect Cable

CHAPTER 3
OPERATION

3.1 GENERAL

This chapter includes the operational description for the DF112 modem when mounted in either the standalone or multiple modem enclosure. The operation of the controls and indicators are the same regardless of the type of enclosure (see Figures 3-1 and 3-2). The only difference is that the controls and indicators for the standalone are horizontal; in the multiple modem enclosure, they are mounted vertical.

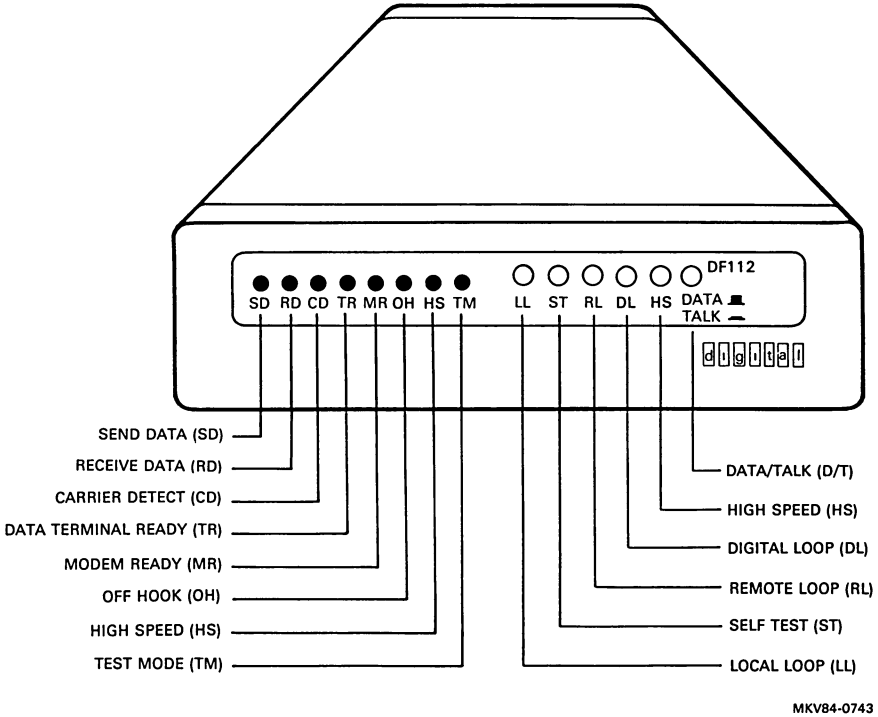


Figure 3-1 Standalone DF112 Modem Controls and Indicators

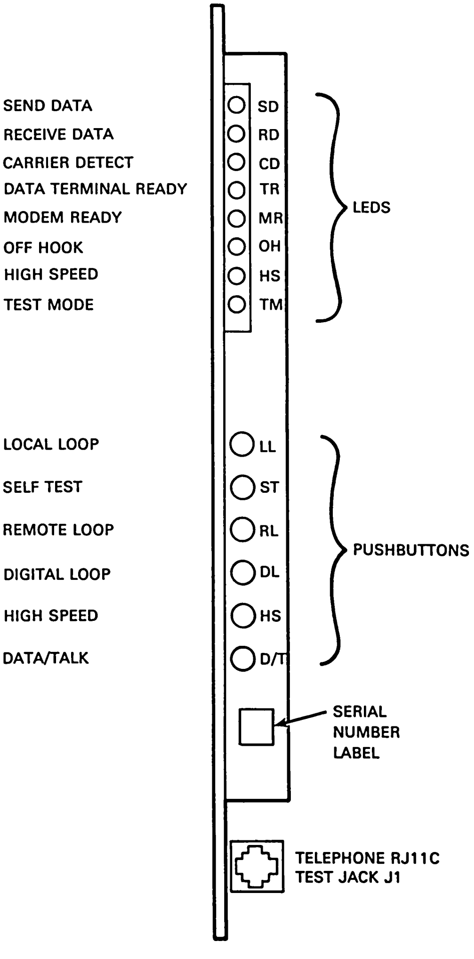


Figure 3-2 Multiple Modem Controls and Indicators

The DF112 modem is compatible with any EIA RS-232-C, ASCII, terminal. When using a VT200 terminal family with the DF112 modem, the terminal must be set to VT100 emulator mode for proper ASCII character response. VT200 mode causes erroneous characters to be displayed.

The auto dialer is also described in this chapter. The auto dialer is an integral part of the modem and will initially only accept a Control A or Control B from the terminal to activate auto dial. Any other character entered at the terminal causes an error to be displayed (see Section 3.4 for auto dial).

3.2 CONTROL SWITCHES AND INDICATORS

The DF112 Modem contains six pushbuttons switches and eight Light-Emitting Diode (LEDs) indicators. Figure 3-1 illustrates the standalone configuration and Figure 3-2 shows the multiple modem enclosure layout. Tables 3-1 and 3-2 provide a description of each function.

Table 3-1 DF112 Modem Front Panel LED Indicators

Indicator	Status	Function
Send Data (SD)	On	Modem is transmitting data.
	Off	Modem is not transmitting data.
Receive Data (RD)	On	Modem is receiving data.
	Off	Modem is not receiving data.
Carrier Detect (CD)	On	Audio carrier from a remote modem is present.
	Off	Carrier is not present.
Data Terminal Ready (TR)	On	Data terminal equipment (DTE) is ready to send or receive data.
	Off	Data terminal equipment is not ready to send or receive data.
Modem Ready (MR)	On	Modem is ready to send or receive data.
	Off	Modem is not ready to send or receive data.
Off Hook (OH)	On	Modem is ready to accept data from the DTE.
	Off	Modem is not ready to accept data from the DTE.
High Speed (HS)	On	Modem is operating at 1200 b/s.
	Off	Modem is operatimg at 300 b/s.

Table 3-1 DF112 Modem Front Panel LED Indicators (Cont)

Indicator	Status	Function
Test Mode (TM)	On	Modem is in the test mode.
	Off	Modem is not in test mode.
Power Regulator Indicators	Multiple modem enclosure only	
Power Status	On	Power to the regulator board is normal.
−12 Vdc	On	Power supply outputs are normal.
+12 Vdc	On	
+5 Vdc	On	

NOTE

An Off condition on any power indicator indicates a power supply problem.

Table 3-2 DF112 Modem Front Panel Pushbutton Controls

Pushbutton	Status	Function
Local Loop (LL)	In	Modem is placed in an analog loopback test mode of operation. Modem is also placed OFF HOOK, presenting a busy condition to the line to accommodate hunt chain equipment.
	Out	Analog loopback is disabled.
Self-Test (ST)	In	Modem is placed in a self-test mode of operation, generating a special test pattern.
	Out	Self-test is disabled.
Remote Digital Loop (RL)	In	Remote station connected to the modem is placed in digital loopback mode.
	Out	Remote digital loopback is disabled.

Table 3-2 DF112 Modem Front Panel Pushbutton Controls (Cont)

Pushbutton	Status	Function
Digital Loop (DL)		This switch performs two different functions depending on the type of link configuration as explained below.
Dial-Up PSTN	In	Modem is conditioned for digital loop test, enabling testing from a remote location.
	Out	Modem is enabled for normal data operation.
Private Line	In	Modem is set to Answer Mode
	Out	Modem is set to Originate Mode.
High Speed (HS)	In	Modem is conditioned to transmit in the high speed mode at 1200 b/s.
	Out	Modem is conditioned to transmit in the low speed mode at 300 b/s. The HS pushbutton has no effect on incoming calls because the receiving modem automatically adjusts to the proper speed.
DATA/TALK (D/T)	In	Conditions the modem for voice communications.
	Out	Conditions the modem for serial binary data communications.

3.3 USING THE DF112 ON DIAL-UP SERVICE

The DF112-AA standalone modem can operate in one of four standard modes;

1. Manual Originate
2. Manual Answer
3. Automatic Originate
4. Automatic Answer

The DF112 is designed to be either an originate or answer modem that operates either manually or automatically. If someone lifts the handset from the telephone to originate a call with the DATA/TALK front panel switch in the DATA (OUT) position, the user will not hear the dial tone. To obtain a dial tone and originate a call, the DATA/TALK switch must be in the TALK (IN) position. Failure to place the modem in the TALK position and placing the handset back on the telephone with the modem in the DATA position causes the modem to lock up in a busy (off hook) condition. The only indication of this busy condition is that the TR, MR and OH indicators will be ON even though the handset is back on the telephone. To reset this condition, place the DATA/TALK switch to the TALK position then back to the DATA position or drop Data Terminal Ready.

When mounted in the multiple modem enclosure, the DF112 modem does not have provisions for external RJ11C connections, therefore, DF112 modems can only operate in two standard modes: automatic originate and automatic answer. However, for maintenance purposes, the DF112 modem can operate in manual modes using a standard telephone set with RJ11C plug connected to the test jack (J1) on the modem module (see Figure 3-2).

3.3.1 Manual Originate Mode

To manually originate a call with a standalone or multiple modem configuration with maintenance telephone, perform the following.

1. Set the LL, ST, RL, and DL pushbuttons to the OUT position.
2. Verify that the CD indicator is OFF and that the TR indicator is ON. TR is asserted from an on-line, powered-up terminal or system.
3. Set the HS pushbutton for the desired speed.

   IN = 1200 b/s
   OUT = 300 b/s

4. Set the DATA/TALK (D/T) pushbutton to the TALK (IN) position.
5. Lift the telephone handset and listen for a dial tone.
6. Dial the location (phone) number.

NOTE

If the call is anwered manually, ask the station attendant to prepare the modem at that location for data reception by either placing the DATA/TALK (D/T) pushbutton to the DATA (OUT) position.

7. When the answer tone is heard, set the originate modem DATA/TALK (D/T) pushbutton to the DATA (OUT) position.

8. Hang up the telephone handset.

9. Verify that the MR and CD indicators are ON. If high speed mode is selected, the HS indicator is also ON.

3.3.2 Manual Answer Mode

To manually answer the phone on a standalone or multiple modem configuration with maintenance telephone, perform the following procedure.

1. Verify that the TR indicator is ON and that the DATA/TALK (D/T) pushbutton is in the TALK (IN) position. All other pushbuttons are in the OUT position. TR is asserted from an on-line, powered-up terminal or system.

2. When the telephone rings, answer it and listen.

3. When the call originator asks you to prepare for data reception either place the DATA/TALK (D/T) pushbutton in the DATA (OUT) position, and hang up the telephone handset.

4. Verify that the mode changes from TALK to DATA by ensuring that the MR and CD indicators come ON. Once these two indicators are ON, the modem is considered "ON-LINE" and data is transmitted and received.

NOTE

The answering modem adjusts to the speed of the originating modem regardless of the HS setting.

3.3.3 Automatic Answer Mode

The automatic mode of operation is just as the title implies. The DATA/TALK (D/T) pushbutton must be in the DATA (OUT) position and the auto answer option switch (see Chapter 5) must be enabled to allow the call to be automatically answered. When an automatic answer modem receives a call, it automatically answers and establishes communications. The speed of the receiving modem is automatically set to the same speed as the originating modem.

3.3.4 Automatic Originate (Auto Dial)

The auto dial feature allows the user to call a remote modem either from a terminal keyboard or from a computer instead of from a standard telephone. A variety of commands and functions are available for making calls automatically. Section 3.4 provides detailed descriptions, procedures and examples on using the auto dial features.

3.4 AUTO DIAL FEATURE

The auto dialer is an electronic device that imitates the manual action of a person dialing a telephone number sequence. A person may dial many different number sequences depending on a variety of different circumstances. For example, in many business offices, a special access code may be required to obtain an outside telephone line. Further, an area code may be required. And even more complex are international calls containing many special codes and pauses for any number of reasons, including perhaps one or more dial tones.

The auto dialer can be used with both rotary pulse and Touch Tone TM telephone systems. In the dialing sequence, a "P" is used to identify rotary pulse digits and "T" is used for touch tone digits. In some telephone systems it may be necessary to use both P and T in the same number string. Remember, there are many combinations of dial codes, access codes, pauses and groups of digits depending on the type of telephone service and where you may be calling. All of these human actions and variations in telephone systems and service must be considered and duplicated by the auto dialer when it is expected to make the call.

A variety of commands and response messages are available to the user to communicate with the auto dial feature to place a call under terminal control or software control. The commands are listed in Table 3-3 and explained below, while the response messages are detailed in Table 3-4.

Table 3-3 Valid Auto Dial Characters

Valid Characters	Function
CTRL/A	Activates the auto dial feature in BURST mode. Typically used with computer configurations or intelligent terminal with memory storage (answerback message feature). If any character other than control B (or control A) is entered, the ERROR response is displayed.
CTRL/B	Activates the auto dial feature in INTERACTIVE mode. This mode provides system responses to prompt the user of actions taken. The first response to control B is **READY**. IF any character other than control B (or control A) is entered, the ERROR response is displayed.
CTRL/C	In manual answer mode, pressing control C connects the modem to the line, but only if the DATA/TALK pushbutton is in the DATA (OUT) position. Also if TR is ON, pressing control C places the modem OFF HOOK.
P	Indicates pulse dialing of digits that follow.
T	Indicates tone dialing of digits that follow.
	NOTE **If a dial code (P or T) is not specified in the number string, the default is pulse (P) dialing. Also, both types of dialing codes may be used in the same number string.**
=	Access pause – Causes a pause period of 15 seconds to wait for secondary dial tone. If a dial tone is not detected within 15 seconds, the auto dialer responds with the NO DIAL TONE message.
#	Indicates end of the number string: start dialing.
Digits 0 – 9	Digits that make up the telephone number.

Table 3-3 Valid Auto Dial Characters (Cont)

Valid Characters	Function
Letters A, B, C, or D	When entered at the end of a number string, the letter identifies a memory location for storing that number. When entered at the READY response, the dialer displays the number stored at that location.
Carriage Return (CR)	Pressing CR at the READY response displays the current number in current number storage register.

NOTE

The auto dialer accepts either upper case or lower case entries. The auto dialer does not accept the hyphen (-) character or space character. This allows the auto dialer to operate more efficiently, because it does not have to be concerned about non-essential characters.

Table 3-4 Response Messages

Response Message	**Definition**
[R]eady	Indicates that auto dialer is ready to perform one of the tasks listed below. This response message is always used to indicate that the dialer is ready with one exception; when control A is used, the initial READY response is omitted. 1. Accept a new number 2. Dial current number 3. Store number in memory or 4. Retrieve stored number

Table 3-4 Response Messages (Cont)

Response Message	Definition
[E]rror	Indicates that the modem is not ready (control B not issued) or that an invalid entry was made in the dialing string. Using invalid character such as space, hyphen (-), comma (,) or slashes (/) in the number string causes errors. This response places the modem in an idle state which requires a control A or control B to reactivate the auto dialer.
[A]ttached	Indicates remote end has answered and responded with answerback tone.
[N]o Answer	Indicates remote end has not answered the call within the allotted time of 30 seconds. This response places the modem in an idle state which requires a control A or control B to reactivate the auto dialer.
[N]o Dial Tone	Indicates a dial tone was not detected within the allotted time of 15 seconds after initiating a call. This response places the modem in an idle state which requires a control A or control B to reactivate the auto dialer.

NOTES

1. **Some telephone company error messages may accidentally trigger the secondary dial tone detector and/or the answer tone detector, causing a false ATTACHED response from the auto dialer which places the modem in data mode. If this occurs, check the dialed number and try again.**

2. **For long form response messages, switchpack S3, switch 3 must be set to the OFF position. For short form (abbreviated), set switch 3 ON. See Chapter 5 for details.**

[ ] Brackets indicate valid CPU mode abbreviations.

The auto dialing sequence is issued either manually by an operator from an sysnchronous terminal keyboard or from a computer, by software control using special routines embedded in the user's program. In either case, the procedure follows a similar sequence, except that under program control it is necesary that the program properly interpret the response characters and take the correct action(s).

To auto dialer is capable of storing 5 (26 characters) telephone numbers; four numbers stored in alpha indexed storage registers and one number stored inthe current number register. The current number register always stores the last number entered into the auto dialer regardless of whether the number was entered from a terminal, computer or from one of the alpha indexed storage registers.

NOTES

1. **Stored numbers are not saved when modem is powered down.**

2. **The DF112 modem including the auto dial feature automatically sets the speed to match the terminal or CPU speed.**

The auto dialer provides a dialog that allows the user to communicate with the modem and automatically dial telephone numbers from a terminal or computer. This dialog is activated using one of two modes;

1. Interactive Mode or
2. Burst Mode

The interactive mode is most generally used when the modem is connected to a terminal. A control B (^B) must be entered at the terminal keyboard or embedded in the user's program routine to activate interactive mode. The auto dialer immediately responds with a READY message that indicates it is ready. If the auto dialer does not immediately respond to control B with READY, then the modem or associated terminal or CPU may have a problem. All user inputs except control B are echoed back to the DTE (displayed on the screen if the DTE is a terminal).

Burst mode is similar to interactive mode, but requires a control A (^A) to activate the dialing sequence. The only difference is that the initial READY response is not issued by the auto dialer as in interactive mode. All other response messages are identical to interactive mode, including subsequent

READY conditions. Only the first READY response is omitted. This mode is typically used by a computer or intelligent terminal with memory store capability to save time. Without having to wait for the READY response the computer can operate more efficiently. Burst mode assumes that the auto dialer is ready and allows the computer or terminal to issue the telephone number to the auto dialer immediately following the control A. Also, in burst mode, all user inputs are not echoed back to the DTE (not displayed on the terminal).

3.4.1 Dialing Numbers

Dialing a telephone number is done simply by entering the number at the ready condition for interactive mode (see Example 1), or immediately following control A in burst mode (see Example 2).

In Example 2, the answerback message feature of a VT100 terminal is used to demonstrate burst mode. This feature may differ on ohter video terminals. Be sure to refer to appropriate user guides for setting up the answerback message feature. For the VT100, the set up procedure is included in the message.

Both types of dialing codes (P or T) can be used within the same number string as shown in Example 3. The number string must be terminated by the # symbol, as shown in the examples, to start dialing. The last number dialed is always stored in the current number register for immediate redial. However, if a number is entered and just stored in one of the storage areas (not dialed) it replaces the number in the current number register. Appropriate system responses are given to indicate calling status (see Table 3-4).

EXAMPLE 1: INTERACTIVE MODE DIALING

<∧B>	Enter control B; activates auto dialer. <Control B is not displayed (not echoed back to the DTE)>
READY	Dialer responds with the ready message.
T1=6035551212#	Enter number followed by the # symbol. In this example the number is being touch tone dialed. An access pause character is also used to wait for a second dial tone. Then the number, including area code is dialed and also stored in the current number register.

ATTACHED	Answer back tone is received from the remote modem and connection is made. Proceed with normal data transfer activity.

EXAMPLE 2: BURST MODE DIALING - USING VT100 ANSWERBACK

SET-UP B	Press the SET-UP key, followed by the number 5 key to place the VT100 in SET-UP B mode.
SHIFT A	Press the SHIFT and A key simultaneously to start loading the answerback message. The CAPS LOCKS key will not work.
A=	The VT100 responds by displaying A= on the screen.
A=Z	Enter any character except those listed in Table 3-3. This special character (called the delimiter) allows the user to clear the answerback message area and start over if a mistake is made. To correct an error, enter the delimiter again and return to SHIFT A. In the example the letter Z is selected.
A= Z◊T8=p8055551212#	Enter the desired telephone number to be stored. Control characters like control A for burst mode, are displayed as a diamond (◊). Also, remember that the start dialing symbol # needs to be included.
A= Z◊T8=p8055551212#Z	Enter the delimiter again to end the sequence. When it is entered, the number disappears from the screen.
SHIFT S	Press the SHIFT and S key simultaneously to save the answerback message permanently so that it is not lost when the VT100 is turned OFF. Press the SET-UP key to return to normal video operation.

<^BREAK>	Press the CONTROL and BREAK keys simultaneously to send the telephone number to the auto dialer in burst mode. The number is dialed and also stored in the current number register. <Control Break and the complete number sequence is not displayed (not echoed back to the DTE)>
ATTACHED	Answer back tone is received from the remote modem and connection is made. Proceed with normal data transfer activity.

EXAMPLE 3: USING BOTH DIALING CODES

<^B>	Enter control B; activates auto dialer. <Control B is not displayed (not echoed back to the DTE)>
READY	System responds with READY message.
p9=t5551212#	Enter number followed by the # start dialing symbol. Notice the P code for pulse dialing and T code for touch tone dialing. These codes can be either upper or lower case.
ATTACHED	Answer back tone is received from the remote modem and connection is made. Proceed with normal data transfer activity.

3.4.2 Redial Current Number

Dialing the number stored in the current number register simply requires entering the # symbol at the ready condition in interactive mode or following control A in burst mode. To verify the number before dialing, press carriage return to display the number. Dialing codes (T or P) are always displayed as upper case when retrieved from storage. The # key is then used to start dialing (see Example 4). Remember, the current number register contains the last number to be entered into the auto dialer, not necessarily the last number dialed.

EXAMPLE 4: REDIAL CURRENT NUMBER

<^B>	Enter control B; activates auto dialer, <Control B is not displayed (not echoed back to the DTE)>

READY	System responds with READY message.
CR	To verify current number, press carrieage return. This step is optional. To dial without displaying current number, press # key at the READY response or immediately following control A in burst mode.
P7=T5551212	When CR is entered at the READY response, the number in the current number register is displayed, including the dialing codes if they were originally entered.
READY	The READY response is again displayed.
#	Press # symbol key to dial number.
ATTACHED	Answer back tone is received from the remote modem and connection is made. Proceed with normal data transfer activity.

3.4.3 Cancelling a Call –The calling procedure can be canceled in one of three ways.

1. By pressing control B before the start dialing symbol (#).
2. By pressing an invalid key before the start dialing symbol (#).
3. By pressing any key after the start dialing symbol (#) is entered.

Before the number is dialed, a call sequence can be cancelled by pressing control B as shown in Example 5.

A call can also be effectively cancelled when an invalid character is entered in the telephone number string before it is dialed as shown in Example 6. In this case an ERROR message is issued, placing the auto dialer in the idle state which requires a control A or B to reactivate the auto dialer.

A call can also be cancelled after it is dialed by pressing any key, but this must be done before the remote modem answers; that is, a call can not be aborted during the dialing sequence (see Example 7). For touch tone applications, the dialing sequence happens almost immediately. For pulse dialing, the sequence is usually completed in 10 seconds. When the call is cancelled, the auto dialer responds with the NO ANSWER message, placing the auto dialer in the idle state which requires a control A or B to reactivate the auto dialer.

EXAMPLE 5: CANCELLING A CALL BEFORE DIALING

<^B>	Enter control B; activates auto dialer. <Control B is not displayed (not echoed back to the DTE)>
READY	Dialer responds with the READY message.
T8=555122< B>READY	If a wrong number is entered, the call can be cancelled by entering a control B. As soon as the control B is entered, the auto dialer responds with the READY message. Notice that it appears on the same line as the number, immediately following the last digit entered. <Control B is not displayed (not echoed back to the DTE)>
T8=5551212#	Enter the corrected number followed by #.
ATTACHED	Answer back tone is received from the remote modem and connection is made. Proceed with normal data transfer activity.

EXAMPLE 6: ENTERING AN INVALID CHARACTER

<^B>	Enter control B; activates auto dialer. <Control B is not displayed (not echoed back to the DTE)>
READY	Dialer responds with the READY message.
T42=6175-ERROR	As soon as an invalid character is entered (hyphen in this case), the auto dialer responds with the ERROR message. Notice that it appears on the same line as the number, immediately following the invalid entry. Valid characters are listed in Table 3-3.
<^B>	Enter control B to reactivate the auto dialer.

READY	Dialer is again ready.
T42=6175551212#	Enter the corrected number followed by the # start dialing symbol.
ATTACHED	Answer back tone is received from the remote modem and connection is made. Proceed with normal data transfer activity.

EXAMPLE 7: CANCELLING A CALL AFTER DIALING

<^B>	Enter control B; activates auto dialer. <Control B is not displayed (not echoed back to the DTE)>
READY	Dialer responds with the READY message.
T123=45678#<r>	Enter number followed by the # symbol and press any key. Pressing any key, in this example lower case "r", almost immediately cancels a touch tone dialed number. For pulse dialing, wait about 10 seconds before pressing any key, <whatever key that is used is not displayed (not echoed back to the DTE)>
NO ANSWER	Indicates that the call did not so through.

3.4.4 Storing Numbers – The last number dialed is always stored for immediate redial. Whenever a new number is entered into the auto dialer, it replaces the number that was stored in the current number register. Other storage areas identified as A, B, C or D are provided for storing up to 4 additional numbers. These numbers remain in storage until changed using the store number procedure in Example 8 or the modem is powered OFF. To store a number in either interactive or burst mode, simply enter one of the storage codes A, B, C or D immediately following the number. Also, if lower case dialing codes (t or p) are stored, they are displayed in upper case when retrieved from storage.

EXAMPLE 8: STORING NUMBERS

<^B>	Enter control B; activates auto dialer. <Control B is not displayed (not echoed back to the DTE)>

READY	Indicates auto dialer is ready.
T2=1234567C	Enter desired number, including T or P dialing code followed by the desired storage area code. The example specifies area C.
READY	The number is stored in area C, as well as, in the current number register and the auto dialer is again ready. To store another number, enter number followed by storage area code.

3.4.5 Dialing Stored Numbers – Dialing stored numbers is simple. At the ready condition, enter the desired number storage code (A, B, C or D). The system displays (echos) the number for verification and places the number in the current number register. Therefore that number is really stored in two places; 1) in the current number register and 2) in the letter coded area.

Entering the # symbol as shown in Example 9, dials the number retrieved from storage.

Example 10 shows that the remote modem did not answer the call and the call was made again at a later time using the redial feature.

EXAMPLE 9: DIAL STORED NUMBER - ATTACHED

<^B>	Enter control B; activates auto dialer. <Control B is not displayed (not echoed back to the DTE)>
READY	Indicates auto dialer is ready to use.
	Enter storage code A, B, C or D; in this case storage area C.
CT2=1234567	System displays the stored number immediately following the storage code letter, including dial code (T or P) if originally stored. If the dial code is stored as lower case, it is displayed as upper case when retrieved from storage. The number is also placed in the current number register.
READY	Auto dialer again responds with READY>
#	Press # key to dial number.

ATTACHED	Answer back tone is received from the remote modem and connection is made. Proceed with normal data transfer activity.

EXAMPLE 10: DIAL STORED NUMBER - NO ANSWER

<^B>	Enter control B; activates auto dialer. <Control B is not displayed (not echoed back to the DTE)>
READY	Indicates auto dialer is ready to use.
BP5=4445151	System displays the stored number immediately following the storage code letter, including dial code (T or P) if originally stored. If the dial code is stored as lower case, it is displayed as upper case when recalled from storage. The number is also placed in the current number register.
READY	Auto dialer again responds with READY.
#	Press # key to dial number.
NO ANSWER	Answer back tone is not received from the remote modem and call did not go through.
<^B>	Enter control B to reactivate auto dialer. <Control B is not displayed (not echoed back to the DTE)>
READY	Indicates auto dialer is ready to use.
#	Press # key to redial the same number.
ATTACHED	Answer back tone is received from the remote modem and connection is made. Proceed with normal data transfer activity.

3.5 AUTO DIAL ORIGINATE - USING TERMINAL CONTROL

To automatically originate a call using data terminal equipment, perform the following procedure. This procedure emphasizes the use of control B. However, control A would work just as well, the only difference is that the auto dialer does not respond with the initial READY message.

1. Verify that the TR indicator is ON and ensure that all pushbuttons (except the HS pushbutton, which is set to your specific speed) are in the OUT position. TR is asserted from an on-line, powered-up terminal or system.

   NOTE

   For long form response message, switchpack S3, switch 3 must be set to the OFF position; for short form (abbreviated) set switch 3 ON.

2. Enter a control B (CTRL/B). The READY message appears on the terminal screen. Enter the number sequence followed by the #.

3. If the call is answered within 30 seconds, the message "ATTACHED" appears at the originating terminal. If the call is not answered in 30 seconds,"NO ANSWER" is displayed.

4. When connection is established, verify that the following indicators are ON. Have someone verify the remote end.

   a. TR and MR at transmit modem
   b. TR, MR and CD at receive modem

   Proceed with normal communication functions.

5. To terminate a call, the user or CPU program must take some action that will:

   a. Result in turning the TR OFF. Generally, this action depends on the hardware configuration. Some of the more common methods to turn the TR OFF are:

      1) Use the "Shift/Break" key to generate a long space disconnect.

      2) Switching modes between ON-LINE and local mode or

b. Result in loss of carrier by placing the DATA/TALK (D/T) pushbutton to the TALK (IN) position.

Upon termination of a call at the local modem, the remote modem disconnects due to loss of carrier or long spacing condition. These conditions are user selectable options that must be enabled for the disconnection to occur (see Chapter 5).

6. Verify that the MR and CD indicators go OFF and the TR indicator comes back ON.

3.6 AUTO DIAL ORIGINATE – USING PROGRAM CONTROL

The programming procedures for a DF112 modem auto dialer routine are very straightforward. When establishing a call, TR must be asserted and remain asserted throughout the auto dial routine to function with the DF112 modem.

Response messages from the auto dialer can be set to long form (spelled out) or short form (abbreviated) by switchpack S3. To minimize computer overhead, the short form response message format is recommended. Both interactive or burst mode can be used in program control. To reduce computer overhead, burst mode is recommended.

Another programming consideration for using the auto dialer are the invisible (non-printable) characters that accompany each response message. Each response message is accompanied by special leading and trailing carriage return and line feed characters as shown below:

<cr lf>READY<cr lf>

The spaces in the example are used only as separators, they are not included in the response.

NOTE

These special characters are purposely ommitted in Table 3-4 and in Examples 1 through 10 for clarity.

The leading cr/lf response from the auto dialer occur on every response message except in two special cases involving the READY and ERROR messages where the leading carriage return and line feed are omitted. These special cases are typically associated with the use of control B. When a control B is entered to cancel a call, as in Example 1, the resulting READY message appears on the same line. The same holds true if an invalid character is entered in the telephone number string; the ERROR message response would not include the leading cr/lf. It would appear on the same line as the number and invalid character as shown in Example 2.

These same conditions also apply to the use of control A. However, under program control it is not likely that the computer program will include an invalid character in the telephone number or cancel the call because of a wrong number. These two conditions simply should not exist in the program.

A variety of techniques and approaches can be used in designing a program for software control of the auto dialer. Designing a program is only limited by the programmer's imagination and knowledge of the fundamentals in the dialing sequence as detailed in this chapter.

3.7 USING THE DF112 ON PRIVATE LINE

Operating the DF112 on private line connections is simple. Two modem options must be changed from the standard factory settings.

These are:

1. PSTN option (switchpack 3, switch 8) must be set to select PLTN and

2. Digital loop (switchpack 3, switch 7) must be set to select private line. This option allows the front panel DL switch to perform a different function; that is, to select a modem as either the ORIGINATE or ANSWER modem in private line.

See Chapter 5 for detailed instructions on these and other option selections. To establish a private line connection, follow the procedure below.

1. Make sure that switchpack 3, switches 7 and 8 are set to ON in both modems.

2. At one modem, push the front panel DL switch to the IN position to place that modem in ANSWER mode. On the other modem, leave the DL switch in the OUT position to select ORIGINATE mode.

3. With power applied to both modems, observe that the TR indicator is ON.

4. At the ORIGINATE modem, place the DATA/TALK (D/T) switch to the DATA (OUT) position. Then at the other (ANSWER) modem, have the operator place the D/T switch to the DATA (OUT) position. The connection is established, both modems are in data mode and full-duplex operation can occur.

NOTE

The originate modem must be placed in DATA mode before the answer modem to establish the link.

5. To disconnect, place either D/T switch to the TALK position.

CHAPTER 4
TEST PROCEDURES

4.1 GENERAL

This chapter provides modem testing procedures to help isolate data communications problems on the DF112 modem. All test functions include simplified diagrams representing the test features. In test features where a terminal is used, a computer system (interface) could be substituted. These tests are valid for both asynchronous and synchronous operation, except for the remote digital loopback test (see Section 4.4.3).

Some of the following tests use the manual originate mode to execute the test. These tests are basically for the standalone desk top unit. However, these tests can also be executed on multiple modem configurations, provided that a telephone with an RJ11C modular connector is available to connect to the test jack (J1) on the modem module being tested.

The correct procedure to test and verify a modem communications link is shown in Figure 4-1. The four modem test areas are listed below and discussed in the following text.

1.	Test Area 1 – Local Terminal Test	Tests the local terminal. This test does not directly relate to modem testing, however it is always a good idea to test the DTE device to eliminate the posibility that it may be causing problems.
2.	Test Area 2 – Local Loop Test	Verifies that the local modem can transmit and receive data.
3.	Test Area 3 – Digital Loop Remote Test	Verifies the complete network including the remote modem.

4.	Test Area 4 – End-to-End Selftest	Verifies both local and remote modem, separating transmit and receive logic.

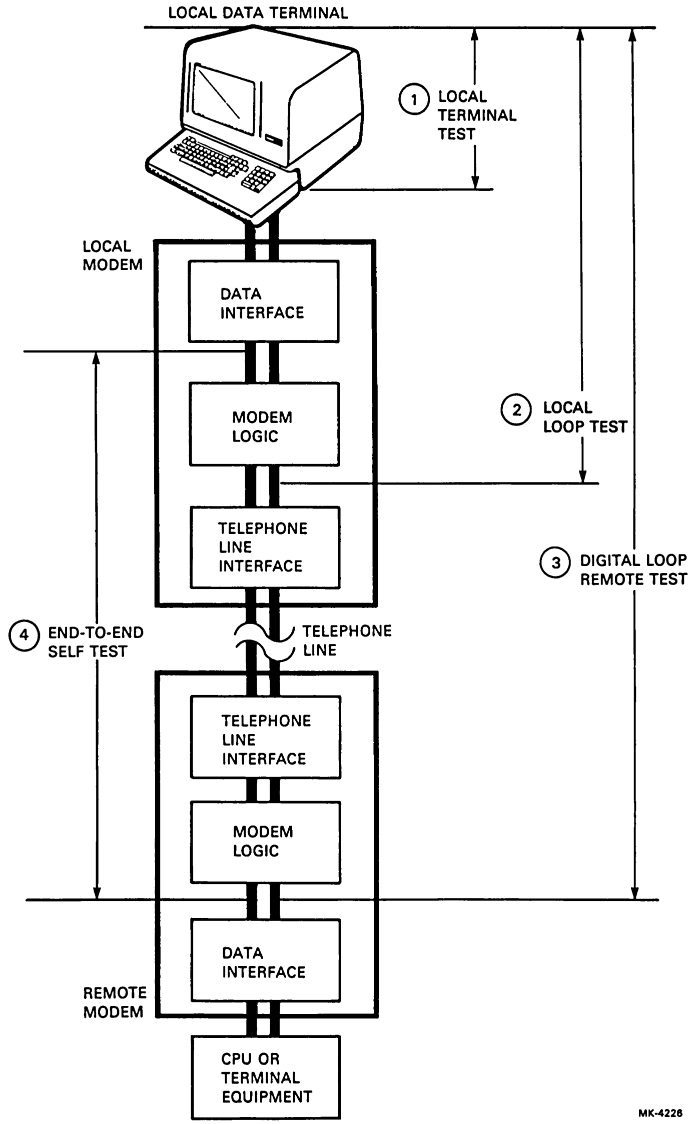


Figure 4-1 Data Path Acceptance Test Sequence

4.2 TEST AREA 1 – LOCAL TERMINAL TEST (FIGURE 4-2)

These tests determine if the terminal or computer interface is working correctly. To verify the terminal or computer interface, perform the following.

- Terminal Test
  - Set terminal to off-line local test and type test message. Verify that correct message is received.
  - Set terminal to on-line and install cable loopback connector (H325) at the end of the DTE cable that attaches to the modem. Repeat test message verification.
- Computer Interface Test
  - Execute a test message with the communication interface set to internal loopback mode and verify that correct message is received.
  - Set the communication interface to normal mode and install cable loopback connector (H325) at the end of the DTE cable that attaches to the modem. Send test message and verify.

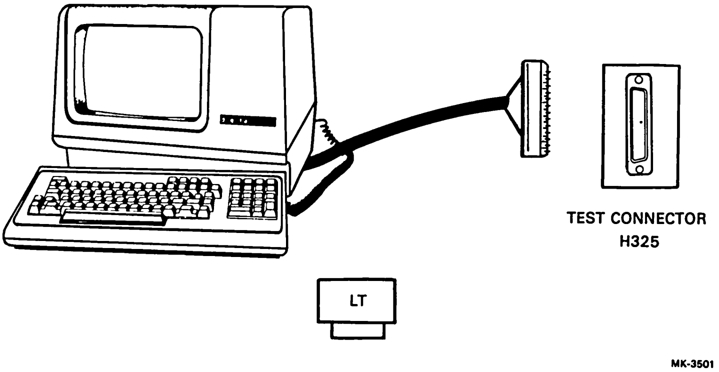


Figure 4-2 Local Terminal Test

4.3 TEST AREA 2 - LOCAL LOOPBACK TEST

Test Area 2 generally has two separate tests: the local loopback selftest and local loopback of DTE data. Both tests verify that the modem can transmit and receive data at the local modem with no errors. Each test is discussed below.

4.3.1 Local Loopback Selftest (Figure 4-3)

This test uses an internal test generator for the transmitter and a test comparator on the receiver to detect errors. If errors occur, the modem carrier (CD) indicator flashes ON and OFF after the test begins.

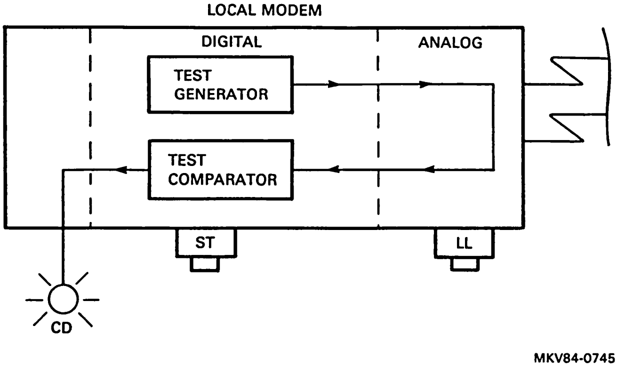


Figure 4-3 Local Loopback Selftest

PROCEDURE:

1. Verify that the CD and MR indicators are OFF.

2. Configure the following test switches.

    a. Set the HS switch to the desired speed.

        IN = 1200 b/s
        OUT = 300 b/s

    b. Set the LL switch to the IN position.

    c. Set the ST switch to the IN position.

d. Set remaining switches to the OUT position.

3. Verify that the TM indicator comes ON. If high speed mode is selected, HS is also ON.

4. Observe that the CD indicator comes ON and stays ON. This may take up to three seconds. It may flash once or twice at the beginning. Verify that the CD indicator never flashes again or goes OFF. If it does, the DF112 modem is defective.

NOTE
This procedure can be performed at the other speed by pressing the HS switch to the other position and repeating the procedure.

5. Release the LL and ST switches to the OUT position to terminate the test.

4.3.2 Local Loopback (Figure 4-4)

This test uses a data terminal or computer interface to input the test message. To verify the data, the operator must observe that the received data is correct. This test is very useful, checking both the terminal and the modem.

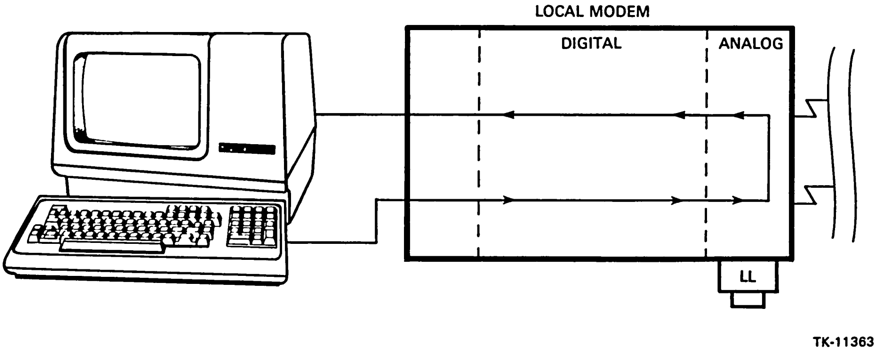


Figure 4-4 Local Loopback

1. Verify that the TR indicator is ON, and the CD and MR indicators are OFF.
2. Configure the following test switches.
   a. Set the HS switch to select the desired speed.

      IN = 1200 b/s
      OUT = 300 b/s

   b. Set the LL switch to the IN position.
   c. Set remaining switches to the OUT position.
3. Verify that the TM indicator comes ON. If high speed is selected, the HS indicator is also ON.
4. Observe that the CD indicator comes ON within three seconds and stays ON.
5. Type a test message on the terminal and verify that the same data is received. Incorrect data indicates a defective modem or wrong terminal speed. Be sure to check terminal speed first, as this is a common problem. The RD and SD indicators will also blink according to the data pattern that is typed.

NOTE

This procedure can be performed at the other speed by pressing the HS switch to the other position and repeating the procedure.

6. Set the LL switch to the OUT position to terminate the test.

4.4 TEST AREA 3 - DIGITAL LOOPBACK TESTS (FIGURES 4-5 THROUGH 4-8)

Test Area 3 has separate tests (similar to Test Area 2) except the test function is digital loopback, with either selftest mode or terminal/computer to provide the test data. The digital loopback tests allow the complete network to be checked including the remote modem logic. This test verifies the telephone line and the receive/transmit logic of the remote modem. This test does not verify any level conversion at the remote modem.

The DF112 modem has four tests that are associated with digital loopback. Two of these tests are local digital loop which uses the DL front panel switch. The other two tests are associated with remote loop which uses the RL front panel switch. The RL switch is functional for both dial-up and private line configurations. The DL switch, however, has two functions. In dial-up configurations, the DL switch functions as local digital loopback. In private line configurations, the DL switch is used select either originate or answer mode. In the OUT position, the DL switch selects originate mode. When pressed IN, answer mode is selected.

The following describes these various modem tests.

NOTE

The RL function allows the local modem operator to force the remote modem to automatically switch to digital loopback. No operator is needed at the remote site.

4.4.1 Digital Loopback Tests (Figure 4-5)

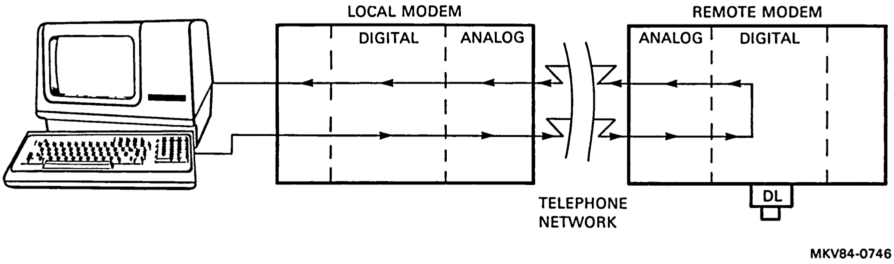


Figure 4-5 Digital Loopback

PROCEDURE:

1. Verify that the TR indicator is ON.

2. Configure the following test switches:

    a. Set DATA/TALK (D/T) switch to TALK position (IN).

b. At remote DF112 modem, have someone press the DL switch to the IN position. Set the HS speed switch to the desired speed.

    IN = 1200 b/s
    OUT = 300 b/s

3. Remove telephone handset from cradle and dial the remote modem. For multiple modem configurations, use a maintenance telephone connected to J1 on the modem module.
4. When call is answered, set the DATA/TALK (D/T) switch to the DATA position (OUT). Place the telephone handset back on the cradle. If an exclusion key telephone is used, simply operate the exclusion key and leave the handset off hook.
5. Verify the CD and MR indicators are ON.
6. Type a test message on the terminal and verify that the same data is received.
7. To terminate, press the DATA/TALK (D/T) switch to the TALK position (IN) or use the shift break keys to generate a long space disconnect. For exclusion key configurations, hang up the handset.
8. If test is performed at computer end, repeat the above procedure. The computer modem now becomes the local modem and the terminal modem is the remote. The computer end will now have to generate the test message and verify the results.
9. Return the DATA/TALK (D/T) switch to DATA position (OUT) if automatic answer mode is enabled.

4.4.2 Digital Loopback Self-Test (Figure 4-6)

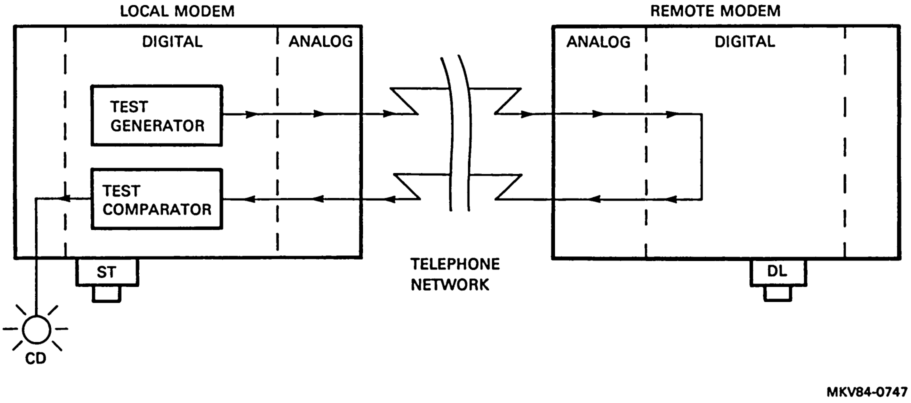


Figure 4-6 Digital Loopback Self-test

PROCEDURE:

1. Verify that the TR indicator is ON.
2. Configure the following test switches:
   a. Set DATA/TALK (D/T) switch to TALK position (IN).
   b. Set ST switch to IN position.
   c. At remote DF112 modem, have someone press the DL switch to the IN position. Set the HS speed switch to the desired speed.

      IN = 1200 b/s
      OUT = 300 b/s
3. Remove telephone handset from cradle and dial the remote modem. For rack modems, use a maintenance telephone con- nected to J1 on the modem module.

4. When the call is answered, set the DATA/TALK (D/T) switch to the DATA position (OUT). Place the telephone handset back on the cradle. If an exclusion key telephone is used, simply operate the exclusion key and leave the handset off hook.

5. Verify that the CD indicator is ON. Observe that the CD indicator never flashes ON and OFF except at the very beginning of the test. If it does, then one of the modems or the telephone network is receiving errors. Return to local analog modem testing or end-to-end self-test to verify modems before suspecting the telephone network.

6. To terminate, release the ST switch and press the DATA/TALK (D/T) switch to the IN position. For exclusion key configurations, hang up the handset.

7. Return the DATA/TALK (D/T) switch to DATA position (OUT) if automatic answer mode is enabled.

4.4.3 Remote Digital Loopback (Figure 4-7)

NOTE

If the modems are configured for synchronous operation and the Terminal Timing slave option is selected at one of the modems (see Table 5-3), this test cannot be performed at that end.

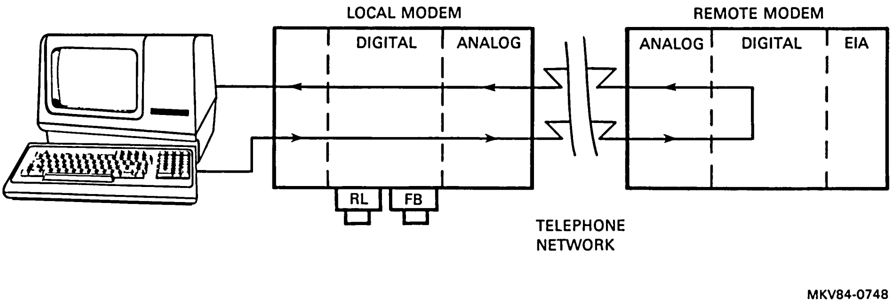


Figure 4-7 Remote Digital Loopback

PROCEDURE:

1. Verify that the TR indicator is ON.
2. Configure the following test switches.
    a. Set DATA/TALK (D/T) switch to TALK position (IN).
    b. Set RL switch to IN position.
    c. Set the HS switch to select the desired speed.

        IN = 1200 b/s
        OUT = 300 b/s

    d. Set remaining switches to the OUT position.
3. Remove telephone handset from cradle and dial remote modem.
4. Set the DATA/TALK (D/T) switch to the DATA position (OUT) when answer tone is heard. Place the telephone handset back on the cradle. If an exclusion key telephone is used, simply operate the exclusion key and leave the handset off hook.
5. Observe that the CD, MR, and TM indicators are all ON.
6. Type a test message on the terminal and verify that the same data is received.
7. Press the DATA/TALK (D/T) switch to TALK position (IN) or use shift/break to terminate the test. For exclusion key configurations, hand up the handset.

NOTE

1. If test is performed at the computer end, repeat the above procedure. The computer modem then becomes the local modem and the terminal modem is the remote. The computer end will then have to generate the test message and verify the results.

2. **This procedure can be performed at the other speed by pressing the HS switch to other position and repeating the procedure.**

8. Return the DATA/TALK (D/T) switch to the DATA position (OUT) if automatic answer mode is enabled.

4.4.4 Remote Digital Loopback Selftest (Figure 4-8)

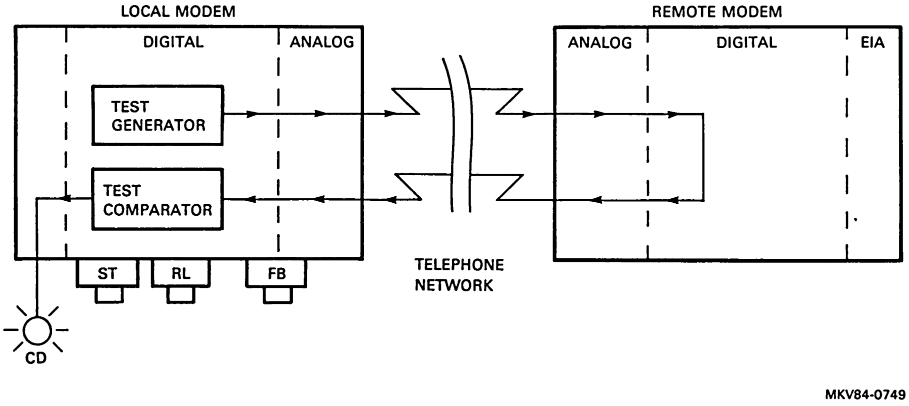


Figure 4-8 Remote Digital Loopback Selftest

PROCEDURE:

1. Verify that the TR indicator is ON.

2. Configure the following test switches.

   a. Set DATA/TALK (D/T) switch to TALK position (IN).

   b. Set the HS switch to select the desired speed.

      IN = 1200 b/s
      OUT = 300 b/s

   c. Set RL switch to IN position.

   d. Set ST switch to IN position.

   e. Set remaining switches to the OUT position.

3. Remove telephone handset from cradle and dial remote modem.

4. Set the DATA/TALK (D/T) switch to the DATA (OUT) position when answer tone is heard. Place telephone handset back on the cradle. If an exclusion key telephone is used, simply operate the exclusion key and leave the handset off hook.

5. Verify that the CD and TM indicators are ON. Observe that the CD indicator never flashes ON and OFF. If it does, one of the modems or telephone network is receiving errors. Return to local modem testing or go to end-to-end selftesting to help isolate the problem.

NOTE

This procedure can be performed at the other speed by pressing the HS switch to the other position and repeating the procedure.

6. Release the ST switch and press the DATA/TALK (D/T) switch to the IN position or use shift/break to terminate the test. For exclusion key configurations, hang up the handset.

7. Return the DATA/TALK (D/T) switch to the DATA position (OUT) if automatic answer mode is enabled.

4.5 TEST AREA 4 - END-TO-END SELFTEST

Test Area 4 allows the local and remote modems to be verified over the telephone network. It separates the transmit and receive logic of both modems. This separation permits better problem isolation. A local modem may check out in the analog loopback test, but fail in the digital loopback test. With this test, if the problem is not the telephone network, the failing transmitter or receiver can be located. Refer to Figure 4-9.

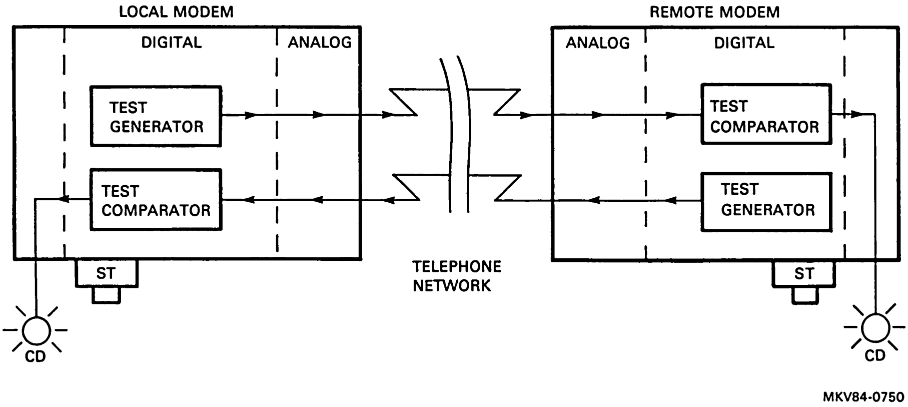


Figure 4-9 End-to-End Self-test

PROCEDURES:

1. Configure the following test switches at both modems.

   NOTE

   This procedure requires a second person at the remote site to set the same switches.

   a. Set the HS switch to select the desired speed.

      IN = 1200 b/s
      OUT = 300 b/s

   b. Set the ST switch to the IN position.

    c. Set DATA/TALK (D/T) switch at remote modem to the DATA position (OUT).

    d. Set DATA/TALK (D/T) switch at local modem to TALK position (IN) to allow dialing remote modem.

    e. Set remaining switches to the OUT position.

2. Remove telephone handset from cradle on local modem and dial the remote modem.

3. Set the DATA/TALK (D/T) switch at the local modem to the DATA position (OUT) when answer tone is heard. Place the telephone handset back on the cradle. If an exclusion key telephone is used, simply operate the exclusion key and leave the handset off hook.

4. Verify that the CD, MR and TM indicators are all ON. Be sure to have the remote operator verify the indicators on the remote modem. Any flashing of the CD indicator means data errors and distortion. Repeat this test more than once to rule out a defective telephone line before determining which modem is defective.

NOTE

This procedure can be performed at the other speed by pressing the HS switch to the other position and repeating the procedure.

5. Release the ST switch and press the DATA/TALK (D/T) switch to the IN position at both modems to terminate the test. For exclusion key configurations, hang up the handset.

6. Return the DATA/TALK (D/T) switch to DATA position (OUT) if automatic answer mode is enabled.

4.6 DF112 AUTO DIAL TESTING

Testing the DF112 for auto dial functions can be easily performed by doing any digital loopback test functions with the DATA/TALK switch in the DATA position (OUT), and dialing the remote modem by using the auto dial message format. If the call is initiated via a terminal and the call is completed, the message "ATTACHED" is displayed on the originating terminal.

A test message may then be sent and the received data verified. If the DF112 selftest mode is used with digital loopback, then the CD indicator must be observed. When the CD flashes, errors are being detected.

CHAPTER 5
MODEM OPTIONS

5.1 GENERAL

This chapter describes the many selectable options that are available on the DF112 modem. As configured at the factory (standard configuration), these modems are designed to be compatible with most commercial data communications equipment. However, these modems have selectable options to provide greater versatility. A detailed description of each option is provided in Table 5-1.

Table 5-1 Detailed Modem Options Descriptions

Option Function	Option/Description	Factory Configuration
Terminal Timing	Allows two possible transmitter timing sources. 1. Internal – Transmit clock from master oscillator on modem module. 2. External – Transmit clock derived from external oscillator source through EIA Pin 24.	Internal
Slave Timing	Transmit clock is derived from receive clock.	Disabled
Loss of Carrier Disconnect	When enabled, the modem terminates the call if carrier is lost for more than 307 ms.	Enable

Table 5-1 Detailed Modem Options Descriptions (Cont)

Option Function	Option/Description	Factory Configuration
Character Length	Selects data character length of 9 bits (7 data, 1 start and 1 stop bit) or 10 bits (8 data, 1 start and 1 stop bit). The last data bit is the parity bit if parity is selected.	10 Bits
Receiver Responds to RDL	When disabled, the receiver logic will not allow remote digital loopback testing.	Enabled
Auto Answer	Selects the modem to operate either in manual mode (disabled) or auto-answer mode (enabled).	Auto
Interface Speed Indication	When enabled, the modem provides an indication of modem speed to the terminal on EIA Pin 12. When Pin 12 is active, 1200 b/s operation is indicated and when inactive, 300 b/s speed is indicated.	Enabled
DSR Indication in ANL	When enabled, data set ready comes on in analog loopback test mode.	Enabled
Speed Mode	Dual mode allows both low and high speed data circuits to operate. High speed only mode selects only the 1200 b/s circuit to operate.	Dual
CTS, CAR Detect Interface Indication	When common, the CTS lead is forced off whenever the CAR detect lead goes off. Selecting	Separate

Table 5-1 Detailed Modem Options Descriptions (Cont)

Option Function	Option/Description	Factory Configuration
	separate mode allows both signals to function independent of each other.	
Mode Select	Selects asynchronous or synchronous operation. This option must be set to sync for synchronous operation.	Async*
Receiver Timing	When enabled, allows receiver timing signal on EIA Pin 17. This option must be enabled for synchronous operation.	Disabled*
Transmit Timing	When enabled, allows transmit timing signal on EIA Pin 15. This option must be enabled for synchronous operation.	Disabled*
Send Space Disconnect	When enabled, the modem transmits 3.95 (+.15) seconds of spacing signal at end of a call, when one of the following conditions occur: (1) DTR is false for at least 50 ms or (2) carrier detect is false for more than 307 ms if loss of carrier option is enabled. This option must be disabled for synchronous operation.	Enabled*
Long Space Disconnect	When enabled, the modem will terminate a call upon receiving about 1.6 (+0.15) seconds of spacing signal. This option must be disabled for synchronous operation.	Enabled*

Table 5-1 Detailed Modem Options Descriptions (Cont)

Option Function	Option/Description	Factory Configuration
Interface Test Mode Indicate	When enabled, places a positive voltage on EIA pin 25 whenever the modem enters any test mode.	Enabled
Dumb Terminal	Forces Clear to Send, Carrier Detect and Data Set Ready to the interface.	Enabled
Interface Speed Select	When enabled, the terminal can select modem speed by controlling EIA Pin 23. When Pin 23 is active, 1200 b/s operation is selected and when inactive, 300 b/s speed is selected.	Disabled
Transmit ** Level Normal	Selects normal transmit level on RJ11C service. Must be disabled if programmed RJ41S or RJ45S service is used.	Enabled
Transmit Level Programmed **	Must be enabled if programmed RJ41S or RJ45S service is used.	Disabled
MI	When exclusion key telephone service is used, the Mode Indicate (MI) option can be enabled to allow the exclusion key button to connect to the line rather than the DATA/TALK switch.	Disabled
Digital Loop or Private Line	Enabled to allow the front panel DL switch to function normally as digital loopback on dial-up PSTN telephone facilities. Disabled for private line use where the front panel DL switch becomes an originate/answer mode	Digital Loop

Table 5-1 Detailed Modem Options Descriptions (Cont)

Option Function	Option/Description	Factory Configuration
	switch. When DL is in the OUT position, modem is set to originate mode. When pressed IN, DL selects answer mode.	
PSTN or PLTN	Selects the type of telephone service to which the modem is connected; switched (PSTN) or private line (PLTN).	PSTN
Normal Dial Tone **	Enabled to detect a standard dial tone. Must be disabled if dial tone detect bypass is enabled.	Enabled
Dial Tone ** Bypass	When enabled, the modem waits 4 seconds for dial tone. If none is detected, the modem assumes that dial tone is present and proceeds to dial. This option is provided for areas where unusual dial tones are used.	Disabled
Interface LL Control †	Enabled to allow the DTE to initiate analog loopback by placing a positive signal on EIA connector Pin 18.	Disabled
Interface RDL Control †	Enabled to allow the DTE to initiate remote digital loopback by placing a positive signal on EIA connector Pin 21.	Disabled

---

*These options must be set opposite to the standard factory settings for synchronous 1200 b/sec operation.

**Only one may be ON, the other must be OFF.

†These functions are only available on DF112-AM REV C modules and above. Below REV C, these functions are hard wired to the EIA pins and cannot be disabled.

Table 5-2 Detailed Autodialer Option Descriptions

Option Function	Option Description	Factory Configuration
Parity Select	This option enables or disables (no parity) autodial parity feature. If this option is enabled, the parity bit must be considered in the character length selection (see Table 5-1).	No Parity
Parity Type	Selects either odd or even parity. This option has no effect if parity select is disabled.	Even
Local Echo	Selects whether or not auto dial functions are echoed back to the DTE.	Enabled
Terminal or CPU	Selects whether the terminal (dial from Keyboard) or CPU is to control auto dial functions.	Terminal

To verify or change any of these options on the standalone modem, it is necessary to remove the front cover to access the DF112-AM module (see Section 5.2). For multiple modem enclosure configurations, simply remove the front door and retainer bar, and pull out the modem module to verify or change switchable options (see Section 5.3).

5.2 STANDALONE MODEM DISASSEMBLY

Disassembly procedures for the standalone modem are simple. Before disassembly, be sure to unplug the power cord from the wall outlet.

To remove the DF112-AM module from the DF100-DT enclosure, simply remove the two slotted screws (from the bottom) closest to the front cover and remove the cover from the enclosure. The module can then be unpluged from the rear connector by pulling the module forward, sliding it out from the card guide (see Figure 5-1).

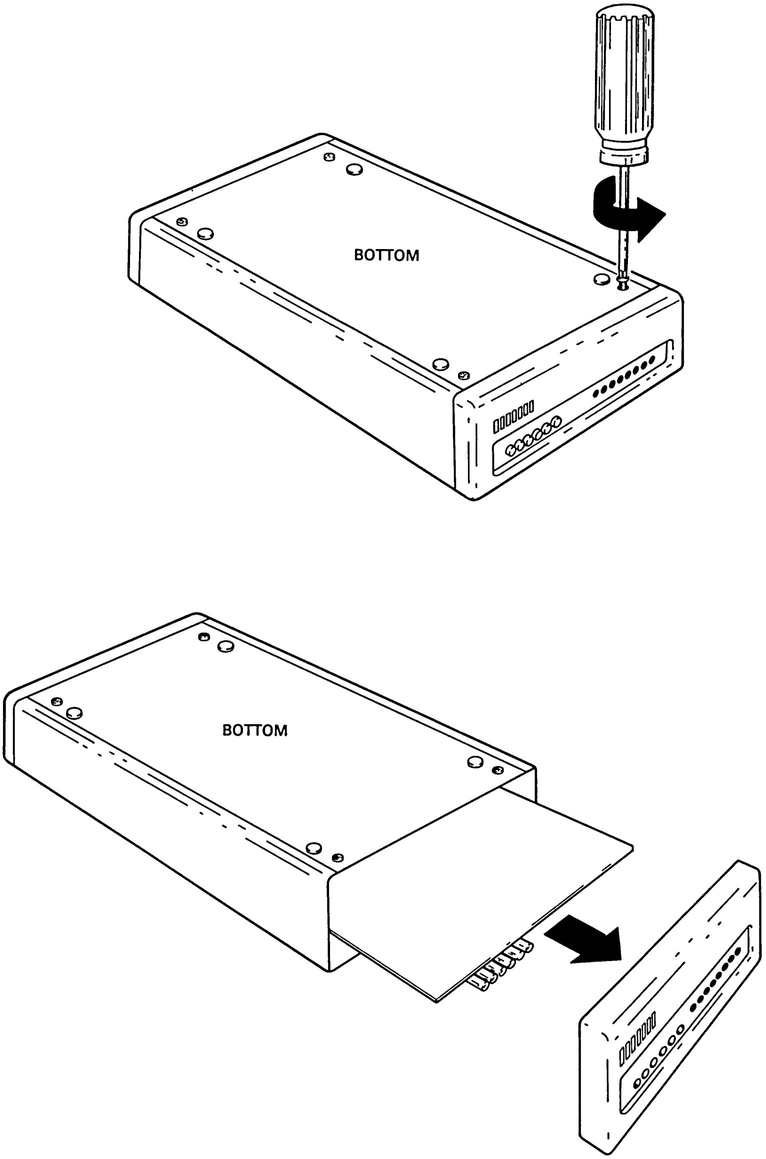


Figure 5-1 Standalone Modem Disassembly

5.3 MULTIPLE MODEM ENCLOSURE DISASSEMBLY

Disassembly of the multiple modem enclosure is accomplished by removing the front door and retainer bar to access the DF112-AM to either change modules or verify switchpack settings. To remove and/or replace DF112-AM modules, it is not necessary to disconnect any of the system cabling. Figure 5-2 illustrates the procedure for removing the front panel and retainer bar.

① Grasp spring latch handles and push in the direction of the arrows. Lift handles to lock into the detent position. Remove the door.

② Remove the screw holding the retainer bar and remove the bar.

③ Remove or insert modem modules as required. Remember, all slots must be filled with either modem modules or filler cards.

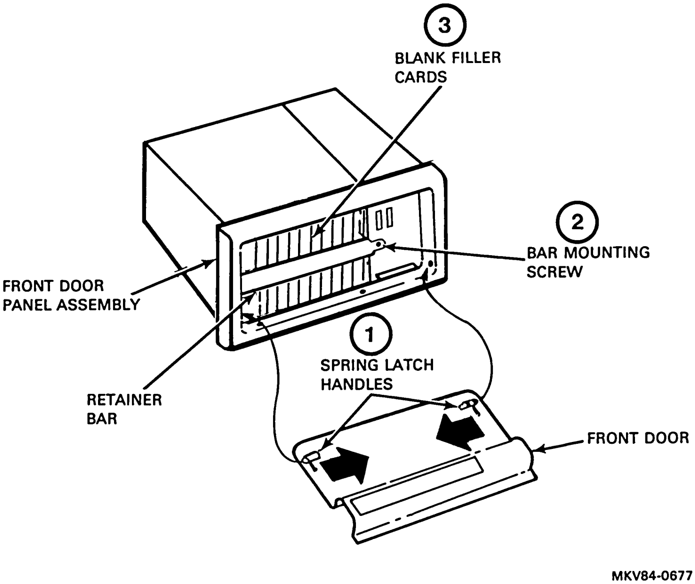
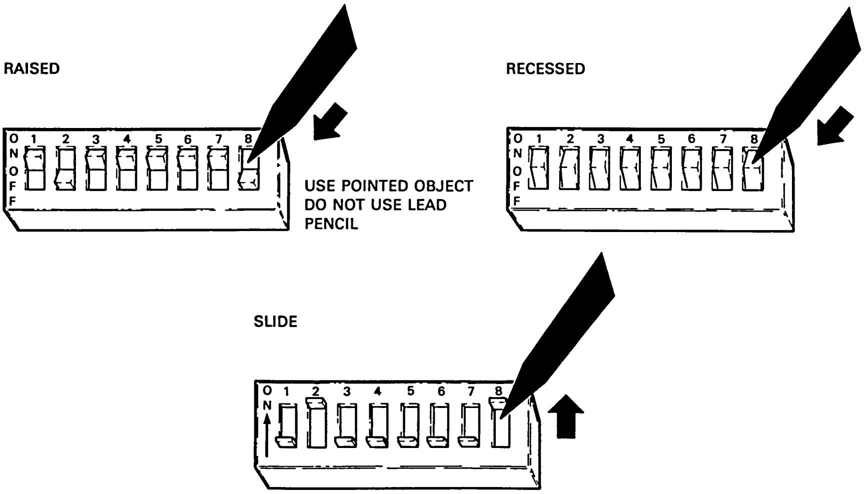


Figure 5-2 Multiple Modem Enclosure Disassembly

5.4 SELECTING SWITCHPACK OPTIONS

The DF112-AM modem module includes a variety of configuration options that are selected by switchpacks.

Modem modules may be equipped with any of three switchpack types shown in Figure 5-3.



NOTE:
PLACING ANY SWITCH TO THE SIDE LABELED ON CAUSES THE SWITCH TO BE CLOSED. PLACING ANY SWITCH TO THE OPPOSITE SIDE (LABELED OFF) OPENS THE SWITCH.

Figure 5-3 Switchpack Variations

5.4.1 DF112-AM Modem Module Assembly

Figure 5-4 shows the general layout of the DF112-AM module, which details placement of pushbutton switches, LEDs, maintenance telephone test jack, dc power fuses and FCC/DOC labels. The location and description of switchpacks and option selections are presented in Section 5.4.2.

Detailed explanations of pushbuttons and LEDs have already been presented in Chapter 3. The test jack is provided for maintenance purposes only, for testing the DF112-AM module with a standard telephone set when the module is mounted in the multiple modem enclosure.

The dc fuses are not field replaceable; they are identified here for information only. However, in cases where faulty operation may indicate a power problem, it might be a good idea to verify that the fuses are not the cause.

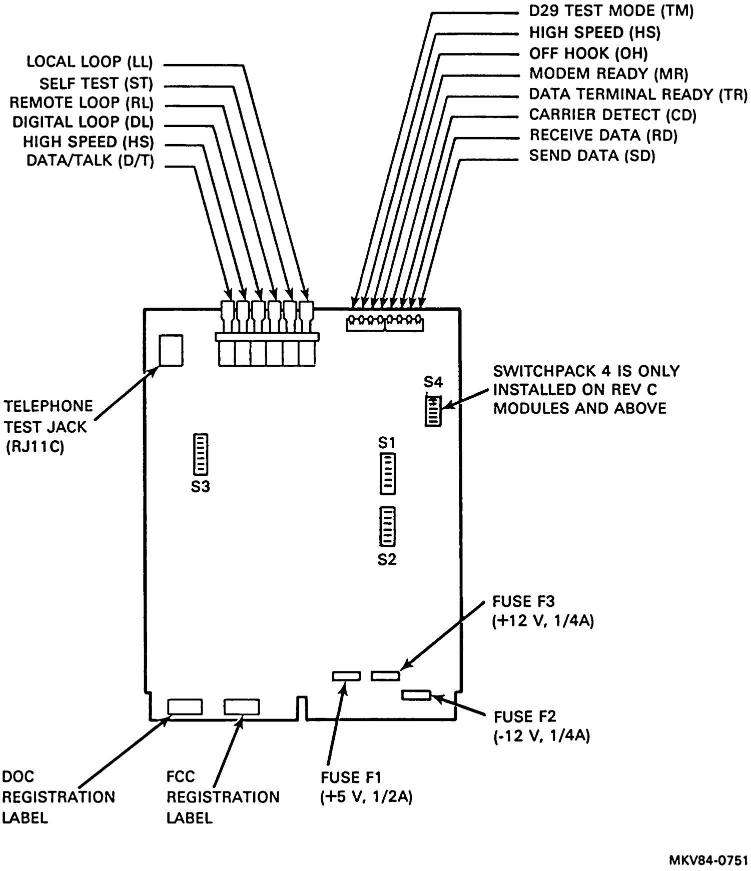


Figure 5-4 DF112-AM Module Layout

5.4.2 DF112-AM Modem Options

The DF112-AM modem module contains four switchpacks (S1 through S4) as shown in Figure 5-5, to select a variety of options. Switchpack S4 is installed on all DF112-AM REV C modules and above. Modules below REV C do not include a switchpack S4 and the functions associated with switchpack S4 are hard wired and always enabled. Tables 5-3 through 5-6 lists each of the switches and the option that is selected. Each module is shipped from the factory with these options preset to select the most popular configurations. In these tables, factory settings are printed in blue for easy reference.

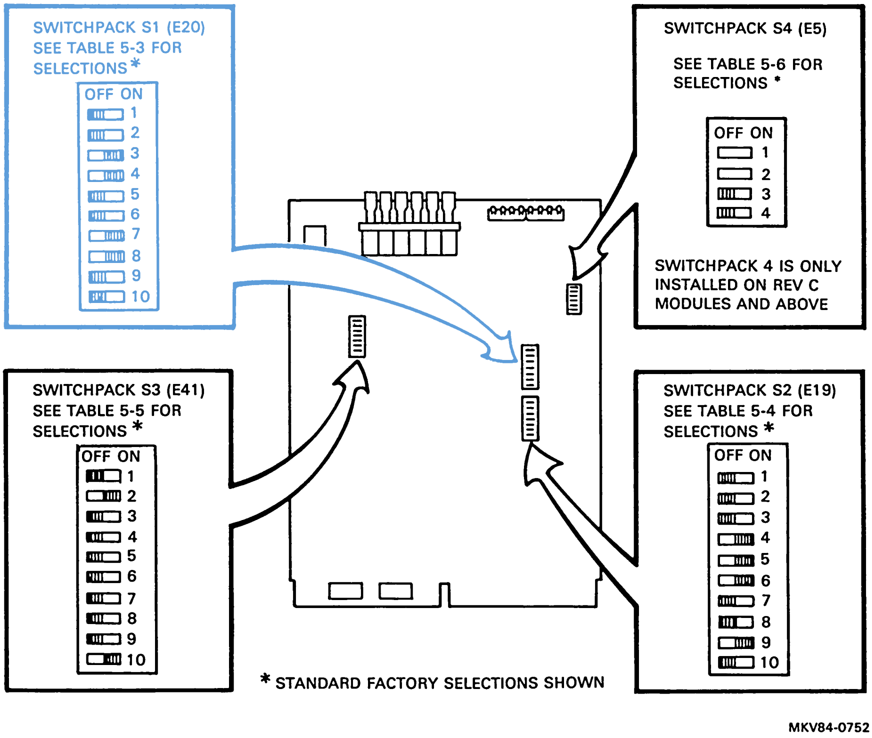
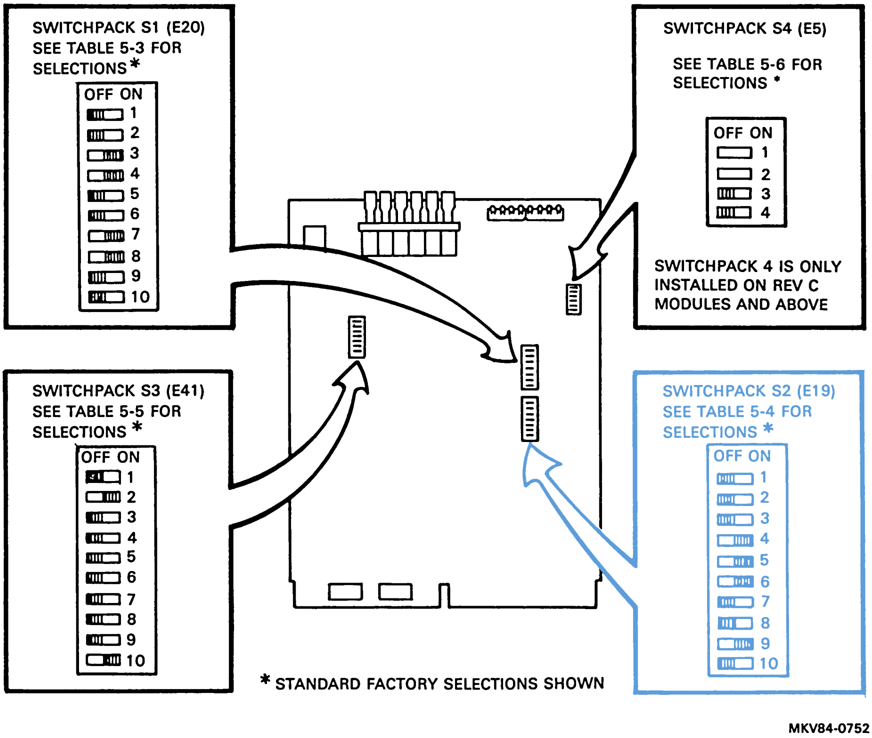


Figure 5-5 DF112-AM Switchpack Locations (Sheet 1 of 4)

Table 5-3 DF112-AM Switchpack 1 Selections

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Terminal Timing	Internal	OFF									
	External	ON									
Slave Timing	Enabled		ON								
	Disabled		OFF								
Loss of Carrier Disconnect	Disabled			OFF							
	Enabled			ON							
Character Length	9 Bits				OFF						
	10 Bits				ON						
Respond to RDL	Enabled					OFF					
	Disabled					ON					
Auto Answer	Auto						OFF				
	Manual						ON				
Interface Speed Indication	Enabled							ON			
	Disabled							OFF			
DSR Indication in ANL	Enabled								ON		
	Disabled								OFF		
Speed Mode	Dual									OFF	
	High Speed Only									ON	
CTS, CAR Detect Interface Indication	Separate										OFF
	Common										ON



* STANDARD FACTORY SELECTIONS SHOWN

Figure 5-5 DF112-AM Switchpack Locations (Sheet 2 of 4)

Table 5-4 DF112-AM Switchpack 2 Selections

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Mode Select*	Async	OFF									
	SYNC	ON									
Receiver Timing*	Enabled		ON								
	Disabled		OFF								
Transmit Timing*	Enabled			ON							
	Disabled			OFF							
Send Space Disconnect*	Enabled				ON						
	Disabled				OFF						
Long Space Disconnect*	Enabled					ON					
	Disabled					OFF					
Interface Test Mode Indicate	Enabled						ON				
	Disabled						OFF				
Dumb Terminal	Enabled							ON			
	Disabled							OFF			
Interface Speed Select	Enabled								ON		
	Disabled								OFF		
Transmit** Level Normal	Enabled									ON	
	Disabled									OFF	
Transmit** Level Programmed	Enabled										ON
	Disabled										OFF

* These options must be set opposite to the standard factory settings for synchronous 1200 b/s operations.

** These switches must be set opposite; that is, only one may be enabled, the other must be disabled.

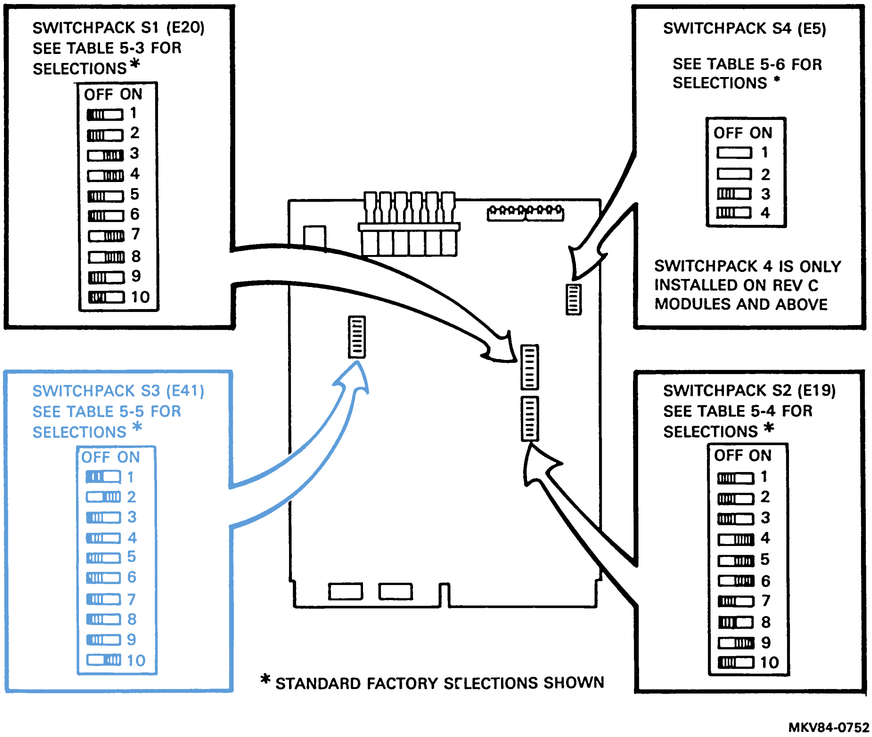


Figure 5-5 DF112-AM Switchpack Locations (Sheet 3 of 4)

Table 5-5 DF112-AM Switchpack 3 Selections

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Parity Select	Parity	ON									
	No parity	OFF									
Local Echo	Enabled		ON								
	Disabled		OFF								
Response Message	Long			OFF							
	Short			ON							
Reserved					NOT USED						
MI	Disabled					OFF					
	Enabled					ON					
Parity Type	Odd						ON				
	Even						OFF				
Digital Loop/ Private Line	Digital Loop							OFF			
	Private							ON			
PSTN or PLTN	PSTN								OFF		
	PLTN								ON		
Dial Tone Bypass *	Enabled									ON	
	Disabled									OFF	
Normal Dial Tone *	Enabled										ON
	Disabled										OFF

*Only one may be ON, the other must be OFF.

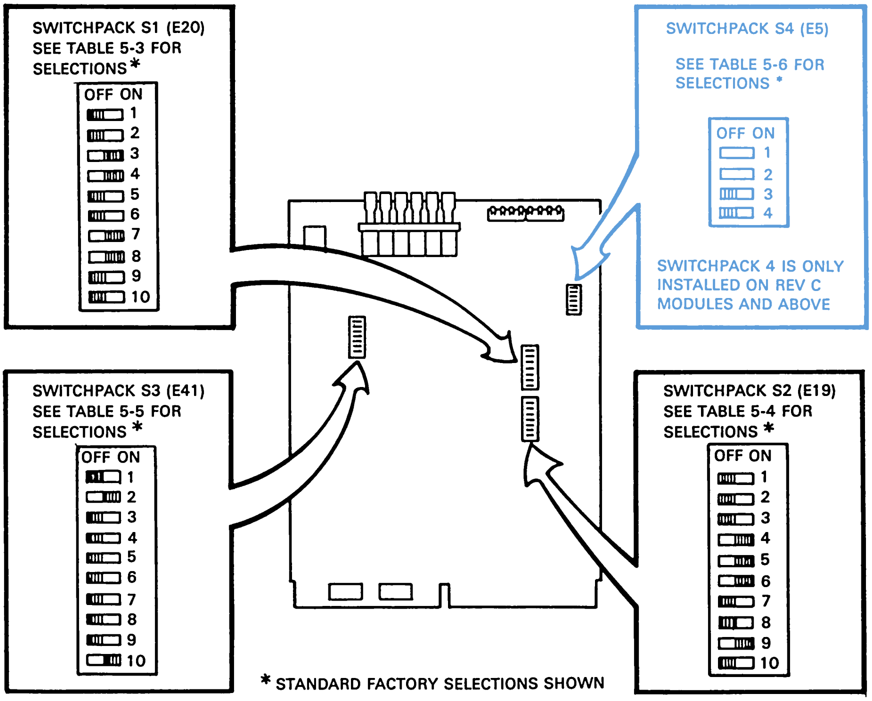


Figure 5-5 DF112-AM Switchpack Locations (Sheet 4 of 4)

Table 5-6 DF112-AM Switchpack 4 Selections

Option	Selection	S1	S2	S3	S4
Reserved		NOT USED	NOT USED		
Interface Remote Digital Loop Control	Enabled Disabled			ON OFF	
Interface Local Loop Control	Enabled Disabled				ON OFF

NOTE

Switchpack S4 is installed on all DF112-AM REV C Modules and above. Modules below REV C do not include a switchpack S4 and the functions associated with switchpack S4 are hard wired and always enabled.

5.5 DF112 REASSEMBLY

5.5.1 Standalone Modem Reassembly

To reassemble the DF112-AA, simply reverse the disassembly process (see Figure 5-6). Things to consider:

1. Be sure correct module is being inserted. Several different types of DIGITAL modem modules can mount in the DF100-DT enclosure.
2. If replacement module is being installed, are the option selections correct?
3. Be sure to push module firmly into the mating connector until it snaps into position.
4. When completely reassembled, run loopback tests to verify that modem is operational (see Chapter 4).

① With the enclosure up-side-down, insert module (components facing down) into the card guides and push module into the enclosure until it touches the backplane. Then press firmly until the module edge connector snaps into mating backplane connector.

② Replace the front cover using the two slotted screws removed earlier.

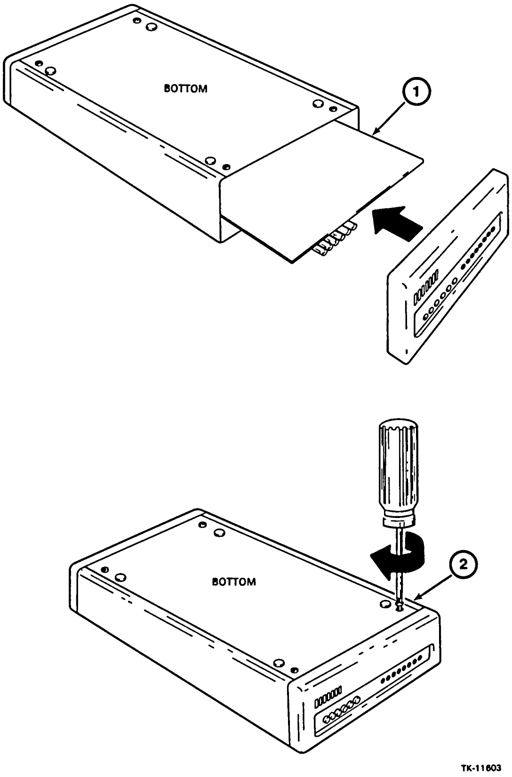


Figure 5-6 Standalone Modem Reassembly

5.5.2 Multiple Modem Enclosure Reassembly

After inserting modem modules and/or filler cards, or verifying switchpacks, reassemble the enclosure as specified in Figure 5-7.

① Insert modem modules (components facing the power supply) into the selected slot. All slots must be occupied with either modem modules or filler cards before the retainer bar is replaced.

② Replace the retainer bar and secure with the holding screw removed earlier.

③ Place the front door into position and release the spring latch handles into the pivot holes on both sides of the door panel assembly.

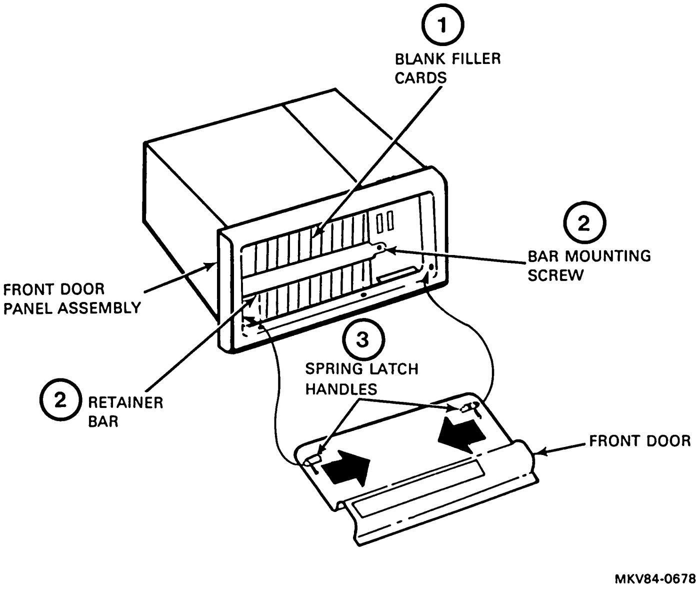


Figure 5-7 Multiple Modem Enclosure Reassembly

CHAPTER 6
SERVICE

6.1 GENERAL

The DF112 Modem family is registered with the Federal Communications Commission for direct connection to the telephone network. The regulations require that all major repairs on the DF112 be performed by Digital Equipment Corporation or its authorized agent. Module replacement however, can be performed by anyone.

6.2 DF112 SERVICE

Digital offers a wide variety of maintenance plans which may include on-site or off-site variations to satisfy almost every need. Some of these plans however, are not offered in certain geographic areas. If you cannot recall which plan, if any, was selected for the system, contact a Digital Equipment Corporation Field Service representative for information about system service.

6.3 TELEPHONE COMPANY SERVICE OR EQUIPMENT PROBLEMS

Problems encountered with the telephone company equipment or service must be reported immediately to the telephone company. It is important, however, to first make certain that the problem is with the telephone company equipment and not with the equipment.

Interfacing between the multiple modem enclosure and the PSTN telephone line is accomplished through the rear panel at connector J13. Refer to Table C-1, in Appendix C, for the TIP and RING pin assignments for each line.

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APPENDIX A
LOOPBACK QUICK REFERENCE GUIDE

A.1 GENERAL

The DF112 Loopback Quick Reference provides summary information on the positions of all pushbuttons and the conditions of all indicators for the DF112 tests. Refer to this summary when performing test procedures.

DF112 QUICK REFERENCE

Analog Loopback Selftest

1.	All pushbuttons	OUT
2.	CD and MR	OFF
3.	HS	
	1200 b/s	OUT
	300 b/s	IN
4.	LL and ST	IN
5.	CD (one minute)	ON
6.	To Terminate –	
	LL and ST	OUT

Analog Loopback Test

1.	All pushbuttons	OUT
2.	TR	ON
3.	CD and MR	OFF
4.	HS	
	1200 b/s	OUT
	300 b/s	IN
5.	LL	IN
6.	TM	ON
7.	CD (within three seconds)	ON
8.	Enter data by terminal or CPU	
9.	To Terminate –	
	LL	OUT

Remote Digital Loopback Selftest

1.	TR	ON
2.	LL	OUT
3.	ST, RL and DATA/TALK	IN
4.	HS	
	1200 b/s	OUT
	300 b/s	IN
5.	Dial remote location	
6.	After hearing answer tone	
	DATA/TALK	OUT
7.	CD, and TM	ON
8.	To Terminate –	
	ST	OUT
	DATA/TALK	IN

Errors are indicated by flashing CD indicator.

Remote Digital Loopback Test

1.	TR	ON
2.	LL, and ST	OUT
3.	RL and DATA/TALK	IN
4.	HS	
	1200 b/s	OUT
	300 b/s	IN
5.	Dial remote location	
6.	After hearing answer tone.	
	DATA/TALK	OUT
	Hang up phone	
7.	CD, MR and TM	ON
8.	Enter data by terminal or CPU	
9.	To Terminate –	
	DATA/TALK	IN

Full-Duplex End-to-End Selftest

1.	Establish voice communications with remote station	
2.	LL, ST and RL	OUT
3.	HS	
	1200 b/s	OUT
	300 b/s	IN
4.	ST (both ends)	IN
5.	DATA/TALK	IN
6.	Dial remote station	
7.	After hearing answer tone.	
	DATA/TALK	OUT
8.	CD, MR and TM (both ends)	ON
9.	Terminate	
	ST	OUT
	DATA/TALK (both ends)	IN

APPENDIX B
EIA/CCITT DATA

B.1 CUSTOMER INTERFACE CIRCUIT DESIGNATION

EIA/CCITT connector pin numbers and associated circuit designations are listed in Table B-1. All circuits are defined by EIA RS-232-C except those designated by an asterisk (*). The circuits designated by an asterisk are defined by CCITT V.24.

NOTE
Data terminal equipment can be a computer or a data terminal.

EIA Signals

AA Protective Ground - Circuit 1

Ground is common to the ac power service ground.

AB Signal Ground (Common Return) - Circuit 7

This circuit establishes the common ground reference for all interface circuits.

BA Transmitted Data - Circuit 2

The transmit data signal is serial data input from the Data Terminal Equipment (DTE). This circuit is driven by the terminal equipment and held in a marking condition during intervals between characters or words and, at times, when no data is being transmitted.

Table B-1 Interface Pin Assignments

Pin	EIA/CCITT Designation	EIA/CCITT Function
1	AA	Protective Ground*
2	BA	Transmitted Data*
3	BB	Received Data*
4	-	Not Used
5	CB	Clear-to-send
6	CC	Data Set Ready
7	AB	Signal Ground*
8	CF	Received Line Signal Detector
9	-	Positive Test Voltage (+12V)
10	-	Negative Test Voltage (−12V)
11	CI(Alt)†	Alternate CI Indicate
12	CI	Speed Mode Indicate
13	-	Not Used
14	-	Not Used
15	DB	Internal Transmit Signal Element Timing (Internal)
16	-	Not Used
17	DD	Receive Signal Timing
18	LL†	Analog Loopback Select
19	-	Not Used
20	CD	Data Terminal Ready*
21	RL†	Remote Digital Loopback Select
22	CE	Ring Indicator
23	CH	Data Rate Selector
24	DA	External Transmit Signal Element Timing (External)
25	CN/TM†	Make Busy/Test Mode Indicate

*Required MINIMUM Customer Controlled Interface Circuits

†Defined by CCITT V.24

BB Received Data - Circuit 3

Serial binary data on this circuit is generated by the modem (DCE) in response to signals received on the phone lines. Received data is held in the marking condition whenever the received line signal detector is in the OFF condition.

CB Clear to Send - Circuit 5

This signal is generated by the modem (DCE) to indicate to the Data Terminal Equipment (DTE) that the modem is ready to transmit data.

CC Data Set Ready - Circuit 6

This signal is generated by the modem (DCE) and sent to the Data Terminal Equipment (DTE) to indicate that the modem is not in the test mode and is off-hook, except in the analog loop test mode option is installed.

CD Data Terminal Ready - Circuit 20

This circuit indicates to the modem (DCE) that the Data Terminal Equipment (DTE) is ready for use. This signal, in combination with a ringing indication, connects the modem to the telephone line. An OFF condition causes the modem to disconnect.

CE Ring Indicator - Circuit 22

This circuit indicates a ring condition was detected by the modem (DCE) and sent to the Data Terminal Equipment (DTE).

CF Received Line Signal Detector - Circuit 8

This signal is true when the modem is receiving a signal capable of being demodulated. The received signal must meet all of the quality criteria of frequency, voltage levels, and signal-to-noise ratio. A not-true condition of this signal causes the received data output to be clamped in the marking or OFF state. This signal becomes true 155 ms after detecting an acceptable carrier. Seventeen milliseconds after the carrier is absent or no longer acceptable, this signal becomes false.

CH Data Rate Select - Circuit 23

This circuit is used to allow the Data Terminal Equipment (DTE) to select high-speed or low-speed operation. The speed mode of the answering station is automatically determined from the line signal and the rate selector is ignored. When circuit is active (high) high speed is selected.

DA Transmitter Signal Element Timing [External Data Terminal Equipment (DTE) Source] - Circuit 24

This circuit is used when signal element timing information is selected and the high-speed mode (1200 b/s) with synchronous format is used. Timing must be provided by an external clock source on EIA Pin 24.

DB Transmitter Signal Element Timing [Data Communications Equipment (DCE) Source] - Circuit 15

This circuit is associated with the high-speed synchronous format and operates in conjunction with transmitted data (BA). The timing signal is generated from the internal modem clock source.

DD Receiver Signal Element Timing [Data Communications Equipment (DCE) Source] - Circuit 17

This circuit is associated only with the synchronous format in the high-speed mode and works in conjunction with the received data (BB) circuit.

CCITT Signals

CI Speed Mode Indicate - Circuit 12 (Alternate Circuit 11)

This circuit is in the ON state when the modem is in the high-speed data mode or the high-speed analog loop test mode. At all other times, the CI circuit is in the OFF state. The state of the CI interface circuit does not necessarily correspond with the state of the speed select (HS) pushbutton. This is true since the answering modem automatically adapts to the speed of the originating station each time the data mode is entered, ignoring its own speed selector.

LL* Analog Loop Select - Circuit 18

When asserted by the Data Terminal Equipment (DTE), the analog loop select option is selected. This circuit allows an analog loop test mode to be selected by the Data Terminal Equipment (DTE).

RL* Remote Digital Loop Select - Circuit 21

When asserted by the Data Terminal Equipment (DTE), the remote digital loop select option is selected. This circuit permits a remote digital loop test mode to be selected by the DTE.

TM* Test Mode Indicate - Circuit 25

This circuit is asserted by the modem (DCE) when the interface test mode indicate option is selected. This circuit indicates to the DTE that the modem is in a test mode.

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* Circuits not defined by EIA RS-232-C.

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APPENDIX C
RJ21X (US) OR CA21A (CAN) SIGNAL CONNECTIONS TO CONNECTOR J13

C.1 GENERAL

The table below identifies the TIP and RING connections for the multiple modem enclosure rear panel connector J13.

Table C-1 Telephone Connector (J13) Pin Usage

Line	RING Signal	TIP Signal
1	PIN 1	PIN 26
2	PIN 2	PIN 27
3	PIN 3	PIN 28
4	PIN 4	PIN 29
5	PIN 5	PIN 30
6	PIN 6	PIN 31
7	PIN 7	PIN 32
8	PIN 8	PIN 33
9	PIN 9	PIN 34
10	PIN 10	PIN 35
11	PIN 11	PIN 36
12	PIN 12	PIN 37

NOTE

1. **J13 is a 50 pin connector that can accommodate 25 wire pairs; however, only the first 12 wire pairs are connected.**

2. **These pin assignments comply with U.S. Universal Service Order Code RJ21X and Canadian CA21A service.**

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